EFFECT OF DISTAL RADIO ULNAR JOINT (DRUJ) INVOLVEMENT ON OUTCOME OF DISTAL RADIUS FRACTURES

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BY

DR. SANJAY JAIN

SUPERVISOR

DR. DEEPAK JAIN

DEPARTMENT OF ORTHOPAEDICS
DAYANAND MEDICAL COLLEGE AND HOSPITAL
LUDHIANA
(MAY, 2020)

DECLARATION

I declare that the thesis entitled **"EFFECT OF DISTAL RADIO ULNAR JOINT (DRUJ) INVOLVEMENT ON OUTCOME OF DISTAL RADIUS FRACTURES"** has been prepared by me under the guidance of **Dr. Deepak Jain,** Professor, Department of orthopaedics, Dayanand Medical College and Hospital, Ludhiana. No part of this thesis has formed the basis for the award of any degree previously.

_____

Dr. Sanjay Jain
Department of Orthopaedics
Dayanand Medical College & Hospital
Tagore Nagar
Ludhiana-141001
Punjab

Date:

CERTIFICATE

I certify that **Dr. Sanjay Jain** has prepared his thesis entitled **"EFFECT OF DISTAL RADIO ULNAR JOINT (DRUJ) INVOLVEMENT ON OUTCOME OF DISTAL RADIUS FRACTURES"** for the award of degree of M.S. in Orthopaedics of Baba Farid University of Health Sciences, under my guidance. He has carried out the work at the Department of Orthopaedics, Dayanand Medical College & Hospital, Ludhiana.

Supervisor

Dr. Deepak Jain
Professor
Department of Orthopaedics
DMCH, Ludhiana

Co-Supervisor

Dr. Harpal Singh Selhi
Professor
Department of Orthopaedics
DMCH,Ludhiana

Date:

ENDORSEMENT BY THE HEAD OF THE DEPARTMENT AND PRINCIPAL

This is to certify that the thesis entitled **"EFFECT OF DISTAL RADIO ULNAR JOINT (DRUJ) INVOLVEMENT ON OUTCOME OF DISTAL RADIUS FRACTURES"** is a bonafide research work done by **Dr. Sanjay Jain** under the guidance of **Dr. Deepak Jain**, Professor, Department of Orthopaedics, Dayanand Medical College & Hospital, Ludhiana.

Head of Department

Dr. Rajnish Garg
Professor & Head
Department of Orthopaedics
DMCH, Ludhiana

Principal

Dr. Sandeep Puri
Principal
DMCH, Ludhiana

Date:

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Dr. Sanjay Jain
Department of Orthopaedics
Dayanand Medical College & Hospital
Tagore Nagar
Ludhiana-141001
Punjab

Date:

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Dedicated

To

My Family

And

Teachers

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Dr. Sanjay Jain……..

LIST OF ABBREVIATIONS

AO/OTA	Arbeitsgemeinschaft fur osteosynthesesfragen/ orthopaedic trauma association
AP	Anteroposterior
AE	Above elbow
CT	Computer tomography
DRUJ	Distal radio ulnar joint
DRF	Fracture distal radius
DOB	Distal oblique bundle
DRUL	Dorsal radio ulnar ligament
ECU	Extensor carpi ulnaris
EDM	Extensor digiti minimi
FOOSH	Fall on out stretch hand
FCU	Flexor carpalis ulnaris
FCR	Flexor carpi radialis
GA	General anaesthesia
LTIOL	Lunotriquetral interosseous ligament
MRI	Magnetic resonance imaging
NSAIDS	Non steroidal anti-inflammatory drugs
ORIF	Open reduction and internal fixation
PRE-OP	Pre operatively
POST-OP	Post operatively
PQ	Pronator quadratus
Q-DASH	Quick-disabilities of the arm, shoulder and hand
RTA	Road traffic accident
RA	Regional anaesthesia
RUL	Radio ulnar ligament
SRL	Short radio-lunate ligament
TFCC	Triangular fibro cartilage complex

TFC	Trianglar fibrocartilage
UC	Ulnocarpal
UL	Ulnolunate
UT	Ulnotriquetral
USF	Ulnar styloid fracture
USWP	Ulnar sided wrist pain
UC	Ulnar collateral
VA	Variable angle

ABSTRACT

Introduction: DRUJ injuries associated with DRF remain an injury that fosters considerable interest and debate. DRUJ injuries are the most common cause of residual wrist disability after fractures of the distal radius. There is lack of consensus regarding diagnosis of DRUJ injury including clinical examination, radiographic indices as well as management of DRUJ injury along with fracture of distal radius. We did prospective study of DRF treated with volar plate fixation to study the association of DRUJ injuries with these fractures as well as to look at role of clinical and radiographic indices in diagnosis, management and outcome of these injuries.

Aims & Objectives: To study the effect of distal radio ulnar joint (DRUJ) involvement on outcome of distal radius fractures.

Materials and Methods: A prospective study including 45 patients was carried out in the department of Orthopedics, DMCH. Proforma were filled preoperatively and at 0, 12 week's and final follow-up and Modified Gartland and Werley score were filled and results were tabulated.

Results: We had final follow-up and analysis of 44 cases for which functional outcome was assessed according to Modified Gartland & Werley score. Ten cases had excellent outcome, 23 had good outcome, eight patients had fair outcome and three patients had poor outcome. We found in our study significant relation between ulnar styloid base fractures and functional outcome of DRF.

Conclusion: It is important to recognise DRUJ instability both in axial and AP planes while assessing DRF. Both clinical and radiological parameters needs to be assessed to detect DRUJ involvement. Ulnar variance is a good marker to check for instability in the AP plane by ballotment test. Ulnar styloid base fractures results in DRUJ instability and negatively impact outcome of DRF fixed with volar plating. Ulnar base fracture should be examined for DRUJ instability and fixed if needed.

Keywords: DRUJ instability, DRF, TFCC, ulnar variance, ulnar styloid fracture.

TABLE OF CONTENTS

S. NO.	TOPIC	PAGES
I	INTRODUCTION	1-2
II	AIMS AND OBJECTIVES	3
III	REVIEW OF LITERATURE	4-24
IV	MATERIALS AND METHODS	25-27
V	OBSERVATIONS AND RESULTS	28-47
VI	DISCUSSION	48-52
VII	SUMMARY AND CONCLUSION	53-55
VIII	BIBLIOGRAPHY APPENDICES – I - PROFORMA - MASTER CHART	56-62
	APPENDICES – II - APPROVAL LETTER OF THESIS PLAN - THESIS PLAN	

LIST OF TABLES

TABLE NO.	TITLE	PAGE NO.
1	AGE INCIDENCE	28
2	SEX INCIDENCE	30
3	MODE OF INJURY	31
4	INJURED SIDE	32
5	DOMINANCE OF INJURED HAND	33
6	OCCUPATION	34
7	ASSOCIATED INJURIES	35
8	ASSOCIATED IPSILATERAL UPPER LIMB INJURIES	36
9	AVERAGE INTERVAL TO SURGERY	37
10	TYPE OF FRACTURE	38
11	FRACTURE WITH INTRA ARTICULAR EXTENSION	38
12	NATURE OF DISTAL RADIUS FRACTURE	39
13	NATURE OF DISTAL RADIUS FRACTURE BASED ON AO/OTA CLASSIFICATION	40
14	TYPE OF ANAESTHESIA	41
15	TYPE OF IMPLANT	41

16	AXIAL DRUJ INSTABILITY	42
17	PIANO KEY TEST	42
18	CORRELATION BETWEEN DRUJ INSTABILITY STATUS AND POST OPERATIVE ASSESSMENT	43
19	CORRELATION BETWEEN ABNORMAL ULNAR VARIANCE AND PIANO KEY TEST	43
20	ULNAR STYLOID FRACTURE TYPE	44
21	CORRELATION BETWEEN ULNAR STYLOID BASE FRACTURE AND POST OPERATIVE ASSESSMENT	44
22	POSTOPERATIVE ASSESSMENT	46
23	LOSS OF DORSIFLEXION	47
24	COMPLICATIONS	47

LIST OF FIGURES

FIG. NO.	TITLE	PAGE NO.
1	AGE INCIDENCE	29
2	SEX INCIDENCE	30
3	MODE OF INJURY	31
4	INJURED SIDE	32
5	DOMINANCE OF INJURED HAND	33
6	ASSOCIATED IPSILATERAL UPPER LIMB INJURIES	36
7	NATURE OF DISTAL RADIUS FRACTURE BASED ON AO/OTA CLASSIFICATION	40
8	CORRELATION BETWEEN ULNAR STYLOID BASE FRACTURE AND POST OPERATIVE ASSESSMENT	45
9	POSTOPERATIVE ASSESSMENT	46

INTRODUCTION

Distal radioulnar joint (DRUJ) is a trochoid joint relatively new in evolution. Along with proximal radioulnar joint, forearm bones and interosseous membrane, it allows prono-supination and load transmission across the wrist. Injuries around distal radioulnar joint are not uncommon, and are usually associated with distal radius fractures, fractures of the ulnar styloid and with the eponymous Galeazzi or Essex - Lopresti fractures.[1]

Fracture distal radius (DRF) is an injury seen with high frequency, representing approximately one sixth of all fractures seen in emergency departments.[2] There is also high incidence of malunion even after the fracture is healed. Malunion of the distal radius has been associated with pain, stiffness, weak grip strength and carpal instability in a significant percentage of patients. Early recognition and management at the acute stage aims at the anatomic reconstruction of the distal radioulnar joint. Long term consequences include degenerative arthritis in up to 50% of patients with even minimal displacement in the young adult population.[3] There are numerous treatment modalities available to orthopaedic surgeons in the treatment of fracture distal radius; these include closed reduction and casting, closed reduction and percutaneous pinning by different methods such as kapandji intrafocal pinning, transradial styloid pinning, pinning via the listers tubercle or transulnar pinning. Other modalities of treatment include closed reduction and external fixation by means of ligamentotaxis to realign fracture displacement, open reduction by volar or dorsal approach and internal fixation by different implants such as screws, plates, or screws with locking plate.[4-6]

Distal radio ulnar joint injuries associated with distal radius fractures remain an injury that fosters considerable interest and debate. Distal radioulnar joint instability with distal radius fractures can occur due to disturbance of structural anatomy of distal radius or due to structural damage to TFCC complex. Distal radioulnar joint injuries are the most common cause of residual wrist disability after fractures of the distal

radius. The conditions that produce radioulnar pain and limitation of forearm rotation include instability, joint incongruency, and ulnocarpal abutment.[1] Treatment of distal radio ulnar joint injuries associated with fracture distal radius is controversial: there is no single definitive treatment method that is considered the standard of care. While deciding the treatment modality there are numerous factors to consider before finalizing the most appropriate one for each patient, these include the patient's age, lifestyle, associated injuries, co-morbidities, functional demands, dominance of hand, type of fracture, alignment of fracture, condition of soft tissues, whether the fracture is open or closed and economic constraints of the patient. All these factors play a paramount role in the final decision in the treatment of the distal radio ulnar injuries associated with fracture distal radius.[7] Limited literature is available for the incidence, management and outcomes of these injuries especially in Indian patients.

There is lack of consensus regarding diagnosis of distal radio ulnar joint (DRUJ) injury including clinical examination, radiographic indices as well as management of DRUJ injury along with fracture of distal radius. Mode of DRUJ stabilization has also not been defined so far. Some study have advocated conservative treatment, some had advocated K-wire stabilization or arthroscopic fixation of DRUJ. We did prospective study of fracture distal radius treated with volar plating fixation to study the association of DRUJ injuries with these fractures as well as to look at role of clinical and radiographic indices in diagnosis, management and outcome of these injuries.

AIMS AND OBJECTIVES

To study-

The effect of distal radio ulnar joint (DRUJ) involvement on outcome of distal radius fractures (DRF).

REVIEW OF LITERATURE

Fracture distal radius is most common fracture of upper extremity, representing approximately one sixth of all fractures seen in emergency departments.[2] These fractures have a bimodal distribution with high energy fractures occurring mostly in young men and low energy fractures more in elderly female. In elderlies it has causal relationship with osteoporosis with low bone mineral density being main risk factor as well as a predictor of future fractures.[8-9]

Several radiographic measurements are commonly used for evaluation of distal radius fractures.[10] These are:

Dorsal/palmar tilt: On a true lateral view a line is drawn connecting the most distal points of the volar and dorsal lips of the radius. The dorsal or palmar tilt is the angle created with a line drawn along the longitudinal axis of the radius.[10]

Radial length: This is measured on the PA radiograph. It is the distance in millimeters between a line drawn perpendicular to the long axis of the radius and tangential to the most distal point of the ulnar head and a line drawn perpendicular to the long axis of the radius and at the level of the tip of the radial styloid.[10]

Ulnar variance: This is a measure of radial shortening. Ulnar variance is the vertical distance between a line parallel to the medial corner of the articular surface of the radius and a line parallel to the most distal point of the articular surface of the ulnar head, both of which are perpendicular to the long axis of the radius.[10]

Radial inclination: On the PA view the radius inclines toward the ulna. This is measured by the angle between a line drawn from the tip of the radial styloid to the medial corner of the articular surface of the radius and a line drawn perpendicular to the long axis of the radius.[10]

Dario et al[11] in 2014 conducted a study to find the necessity to restore radial anatomic parameters after distal radius fractures. Their aim was to verify if it is necessary to restore anatomic radiographic parameters to obtain satisfactory functional outcome in distal radius fractures treated with volar plate. They concluded that ulnar variance and volar

tilt are the most important radiographic parameters to be restored to obtain good functional outcome in distal radius fracture.

Distal radioulnar joint is a diarthrodial trochoid synovial joint relatively new in evolution. Along with proximal radioulnar joint, forearm bones and interosseous membrane, it allows pronosupination and load transmission across the wrist. The DRUJ has evolved from the primitive pectoral fin of early fish to the bipedal primate wrist to its current form in human wrist. From the syndesmotic DRUJ of brachiating primates with limited forearm rotation, three major changes occurred,

(a) development of a distinctly separate DRUJ,

(b) recession of the distal ulna from the ulnar carpus, and

(c) development of a distinct ulnocarpal meniscus.[12]

Along with these changes, humans have moved over from a knuckle walking to brachiating arboreal lifestyle to erect bipedal posture with almost 180° of prono-supination.[13]

Distal radioulnar joint consists of two parts—the bony radioulnar articulation and soft tissue stabilizers.

The *radioulnar articulation* is formed by the lower end of ulna (*seat*) and the **sigmoid notch** (medial articular facet) of the distal radius. The sigmoid notch of the radius is concave with a radius of curvature of approximately 15 mm. The ulnar head is semicylindrical, convex, with a radius of curvature of 10 mm.[14] The shape of sigmoid notch is not uniform and has been classified into—1) flat face, 2) ski slope, 3) c type, and 4) s type[15] —which influences the predilection to instability. The flat face type is most susceptible to injuries. The distal articular surface of the ulna (dome or pole) is mostly covered by articular cartilage. At the base of the ulnar styloid is a depression called *fovea*, which is devoid of cartilage. The curvature of the sigmoid notch is about 50% larger than the one of the ulnar head, which gives a significantly larger contact area in neutral position than at the end of pronation or supination. Due to the different curvatures of the radii of the sigmoid notch and the ulnar head, the movement of the radius

through the DRUJ on pronation-supination will be partly translational, partly rotational.[16]

The soft tissue stabilizers are collectively referred to as ulnoligamentous complex[17] or more popularly as the triangular fibrocartilaginous complex (TFCC).[18] It consists of the trianglar fibrocartilage (TFC or articular disk), meniscal homologue, ulnocarpal [ulnolunate (ul) and lunotriquetral] ligaments, the dorsal and volar radioulnar ligaments, ulnar collateral ligament, and the extensor carpi ulnaris (ECU) subsheath.[19] The radioulnar ligaments (dorsal and volar) are the primary stabilizers of the DRUJ. The secondary stabilizers include the ECU subsheath, the UL and ulnotriquetral (UT) ligaments, the lunotriquetral interosseous ligament (LTIOL). The distal interosseous ligament also plays a role in stabilizing the DRUJ. The principal attachment of the TFC, the radioulnar and ulnocarpal ligament is the fovea. The secondary attachment of these structures are the ulnar styloid. A fracture involving the base of the ulnar styloid, therefore, can make the DRUJ potentially unstable. Injuries that destabilize the DRUJ result from disruption of the TFC along with the primary stabilizers, ulnocarpal ligaments, and ECU subsheath. The important function of the DRUJ in load bearing and its effects following injury has been well studied.[20] The DRUJ is very complex and comes in three types:

– Type I where the apposing joint surfaces are parallel to the long axis of the radius and the ulna

– Type II where the apposing surfaces are oblique

– Type III where the apposing surfaces are “reverse oblique”[21]

Blood supply to the TFCC originates from the radiocarpal branches of the ulnar artery and the dorsal and palmar branches of the anterior interosseous artery. The DRUL and PRUL are well vascularized, as is the peripheral 15% to 40% of the articular disk. The inner central portion of the articular disk is completely avascular, with no vessels crossing its radial attachment. Lesions of the TFCC in the central portion (Palmer 1A and Palmer 2) and avulsions from the radial attachment (Palmer 1D) have little potential for healing. Similarly, the

central portion of the TFCC is not innervated. The volar and ulnar portions of the TFCC receive innervation from the ulnar nerve, and the dorsal portion receives sensory branches from the posterior interosseous nerve. A transverse branch from the dorsal ulnar sensory nerve innervates the DRUJ and the overlying Skin. Free nerve endings are present in the ulnar aspect of the articular disc, the ulnar collateral ligament, and the meniscal homolog.[21]

Distal radius fractures

Patient presents with pain and swelling around the wrist and the patient may also complain of a visible deformity if there is displacement of fracture segment. Patient should be examined for any paraesthesia or numbness in the fingers to exclude any median or ulnar nerve injury. A thorough neurologic examination of the hand should be performed as acute carpal tunnel syndrome may require prompt treatment. The standard series of posteroanterior (PA), lateral X-ray views is useful to visualize a suspected fracture of the distal radius.

Mechanism of injury

Most distal radius fractures result from a fall onto an outstretched hand from standing height. Higher energy injuries occur in falls from height, road traffic motor vehicle accidents, and industrial injuries, among others. A dorsally displaced fracture of the distal radius usually occurs when the hand is outstretched with the wrist between 40 and 90 degrees of dorsiflexion. The classical dinner fork or silver fork deformity is caused by dorsal displacement of the carpus secondary to dorsal angulation of the distal radius. Volar shearing fractures and volarly displaced fractures of the distal radius occur with the wrist in volar flexion and the reverse deformity is seen in volar displaced fractures. In addition to the mechanism of injury, increased fracture severity has been shown to be associated with poor bone quality.[10]

Classification of distal radius fractures

Many classification systems have been proposed for fractures of the distal radius and ulna over the years, the majority of which are morphologic and consider in varying degrees the presence or absence of displacement, comminution, and articular involvement

Probably the most widely used classification system in current use is the AO classification, which has been adopted by the orthopaedic trauma association and has been renamed the **AO/OTA classification**.[22] This is an inclusive, alphanumeric classification and has 27 different subgroups. Three different types (a—extra-articular, b—partial articular, and c—complete articular) are divided into 9 main groups and 27 different subtypes depending on comminution and direction of displacement.

AO/OTA classification of distal radius fracture:[22]

A. Extraarticular metaphyseal fracture

A1: isolated fracture of distal ulna

A2: simple radial fractures

A3: radial fracture with metaphyseal impaction

B. Intra-articular rim fracture

B1: fracture of radial styloid

B2: dorsal rim fractures

B3: volar rim fracture

C. Complex intra-articular fracture

C1: radio carpal joint congruity preserved, metaphysis fracture

C2: articular displacement

C3: disphyseal metaphyseal involvement

Several injuries are associated with distal radius fractures, the most common being injuries to the interosseous ligaments and the triangular fibrocartilage complex (TFCC), distal radio ulnar joint injury etc. Other associated injuries include chondral injuries, fractures of the carpus, neurovascular injuries and injuries to the soft tissues, particularly with open fractures.

X-rays of wrist in AP and lateral views are still primary radiographic investigation used to assess type of DRF and articular extension in our country but their role is limited in complex fractures due to observer error. Three-dimensional CT scans are now commonly used in assessing intra-articular fractures of the distal radius. Their use has been shown to improve intra-observer but not inter-observer agreement and to allow a reliable determination of fracture

characteristics which may influence treatment such as coronal fracture lines, central articular depression and articular comminution. The use of this technique has been shown to increase the perceived need for open exposure of displaced articular segments when compared to conventional CT, but the influence of this on functional outcome has yet to be determined.

TREATMENT OF DISTAL RADIUS FRACTURES

There are numerous treatment modalities available to orthopaedic surgeons in the treatment of these injuries; these include closed reduction and casting, closed reduction and percutaneous pinning, closed reduction and external fixation by means of ligamentotaxis to realign fracture displacement, open reduction by volar or dorsal approach and internal fixation by different implants such as screws, plates, or screws with locking plate.[4-6]

While deciding the treatment modality there are numerous factors to consider before finalizing the most appropriate one for each patient, these include the patient's age, lifestyle, associated injuries, co-morbidities, functional demands, dominance of hand, type of fracture, alignment of fracture, condition of soft tissues, whether the fracture is open or closed and economic constraints of the patient.[7] All these factors play a paramount role in the final decision in the treatment of the distal radio ulnar injuries associated with fracture distal radius. Limited literature is available for the incidence, management and outcomes of these injuries.

OPEN REDUCTION AND PLATE FIXATION OF FRACTURE DISTAL RADIUS:

DORSAL PLATING

In radial fractures with apex-volar angulation with dorsal cortical comminution first-generation dorsal plate designs were initially done but were fraught with complications secondary to tendon dysfunction and rupture, which prompted a move to fixed-angle volar plating techniques after the development of angle-stable screws. There is still a role for dorsal plating in certain situations, such as dorsal die-punch fractures or fractures with displaced dorsal lunate facet fragments

where dorsal approach with a low-profile fragment-specific plate is used. Most distal radius fracture open reduction and internal fixation is done using volar plating.[23]

VOLAR PLATING

The popularity of locked volar distal radial plate fixation continues to prompt development of new devices. Several studies demonstrated the biomechanical superiority and better functional results with volar plating over dorsal and radioulnar dual-column plating, external fixation, and percutaneous pinning. However, a complication rate of approximately 15% also has been reported with volar plating, primarily problems are tendon ruptures and tenosynovitis from prominent screws which can be lessened with precise volar plate placement on the metaphyseal area of the distal radius.[24]

Surgical approach for volar plating: Patient is positioned supine on radioluscent operation table with forearm supported on radioluscent side table with palm facing upwards. Tourniquet is applied at upper part of ipsilateral arm.

Landmarks

The styloid process of the radius and the tendon of flexor carpi radialis is palpated. The flexor carpi radialis muscle and tendon lie radial to the palmaris longus muscle at the level of the wrist and just to the ulnar side of the radial pulse.

Incision and exposure: 8-cm incision is made over the forearm between the radial artery and the flexor carpi radialis. The incision is carried to the sheath of the flexor carpi radialis. The sheath is opened and the forearm deep fascia is incised to expose the flexor pollicis longus. Index finger is placed into the wound and the flexor pollicis longus is swept gently ulnarly. The flexor pollicis longus muscle belly is partially detached from the radius to gain full exposure of the pronator quadratus. An L-shaped incision is given over the radial styloid along the radial border of the radius to expose the pronator quadratus and freer elevator is used to elevate it from the radius. The entire fracture line across the distal radius is fully exposed.

Fracture is reduced, volar distal radius plate is placed and locking screws are inserted. After placement of the distal screws, the remaining proximal screws are placed. Fluoroscopic views tangential to the subchondral bone in both the coronal and sagittal planes are obtained to assess for intraarticular penetration. The plate or screws, or both are adjusted as indicated. Wound is irrigated with normal saline. Closure is done layer by layer and aseptic dressing is done.[24]

Kilic et al[25] in 2009 conducted a study to evaluate radiographic and functional results of volar locking plate fixation of unstable distal radius fractures. Their study included 27 patients (15 males, 12 females; mean age 45 years; range 18 to 77 years) who were treated with volar locking plate fixation for unstable DRF. Their postoperative assessments included range of movement and grip strength measurements, and radiographic parameters using the Stewart criteria. They assessed functional results using the Q-DASH (Quick-Disabilities of the Arm, Shoulder and Hand) questionnaire and the Modified Gartland and Werley score. Their mean follow-up was 18 months (range 12 to 34 months). They concluded that volar locking plate fixation is an effective treatment in the anatomical and functional restoration of unstable distal radius fractures.

Omokawa et al[26] in 2017 studied treatment of intra-articular distal radius fractures focussing on detailed morphology of the distal radius to prevent flexor tendon problems after volar plate fixation surgery. They summarize that the watershed line corresponds to the distal margin of the pronator fossa in the radial aspect of the volar radius and to a hypothetical line between the distal and proximal lines in the ulnar aspect. They concluded that the radial and ulnar bony prominences on the volar radius are key structures for accurate plate placement to avoid flexor tendon injury.

DRUJ INJURIES

Forearm supination and pronation is important for optimum function and positioning of the hand in space. Distal radio ulnar joint injuries associated with distal radius fractures remain an injury that fosters considerable interest and debate. The most common cause of residual

wrist disability after DRF is the DRUJ involvement. Three basic causes that result in radioulnar pain and limitation of forearm rotation are instability, joint incongruency, and ulnocarpal abutment. The last two entities initiate irreversible cartilage damage that eventually leads to degenerative joint disease.[27] Early recognition and management in the acute stage aim at the anatomic reconstruction of the distal radioulnar joint including bone, joint surfaces, and ligaments in an effort to reduce the incidence of painful sequelae and functional deficit.

Instability of the DRUJ, results in ulnar sided wrist pain, weakness, and restricted range of forearm rotation. Instability of the DRUJ is frequently associated with distal radius fractures, fractures of the ulnar styloid and with the eponymous galeazzi or essex lopresti fractures. Owing to the attachment site of the deep radioulnar ligaments, a fracture of the base of the ulnar styloid or of the dorsoulnar corner of the distal radius may contribute to DRUJ instability.

Lindau et al[28] in 2000 studied effect of DRUJ instability on outcome of DRF. They assessed 76 young patient for 1 year. Their examination included questions, a visual analogue scale for pain, a physical examination, bilateral radiographic assessment, and wrist score determination according to Modified Gartland and Werley. The DRUJ instability was not correlated to any radiographic variable at the time of fracture or at follow up. The outcome was dependent on the stability of the DRUJ, which in turn was not correlated to any radiographic parameter. They concluded that distal radioulnar instability is an independent worsening factor in distal radial fractures.

Stoffelen et al[29] in 1998 studied the importance of the distal radioulnar joint in distal radial fractures and observed that distal radioulnar joint plays an important role in the outcome of distal radial fractures. An ulnar styloid fracture has a negative effect on outcome and so does involvement of the distal radioulnar joint, as tested with instability tests and forearm rotation strength.

Geissler et al[27] in 1996 conducted a study of distal radioulnar joint injuries associated with fractures of the distal radius. They found that there is a wide variety of injuries to the distal radioulnar joint occurring

in combination with distal radius fractures. They proposed that clinical, radiographic and arthroscopic assessment should be routinely employed to identify the degree and extent of the lesion. They concluded that a successful result is usually dependent on restoration of the joint anatomy which can be accomplished depending on the lesion with conservative or operative measures.

Omori et al[30] in 2013 using 3-D CT scan investigated changes in the length of the radioulnar ligament and distal oblique bundle (DOB) within the distal interosseous membrane in patients with malunited DRF. They found that in a malunited radius, dorsal limbs of the radioulnar ligament were significantly elongated compared with the contralateral side which correlated with radiographic radial shortening and subluxation of the DRUJ. They suggested that overstretching and disruption of the dorsal radioulnar ligament in malunited distal radius fractures with severely increased radial shortening produces laxity in the DRUJ.

The injuries of the DRUJ may involve purely soft tissues or fractures of the radius and/or ulnar styloid or more rarely, isolated dislocations of the joint.

Melone[31] described the traumatic TFCC disruption as a continuum of injury beginning at the ulnar styloid and, with increasing force, extending to the midcarpal joints. It was classified into five stages of increasing severity.

Stage I: Detachment of TFC complex from ulnar styloid

Stage II: ECU subsheath injury

Stage III: Ulnocarpal ligament disruption

Stage IV: Lunotriquetral Ligament injury

Stage V: Midcarpal ligament injury.

Palmer[32] classified TFCC tears into type 1 (traumatic) and type 2 (degenerative). It is further subclassified based on the location of the injury in type 1 or the extent of degeneration in type 2. Type 1A lesions are central tears and are the most common type of traumatic tears. This is not associated with instability of the DRUJ. These injuries can be symptomatic when there is an unstable flap of tissue, which “catch”

on the joint surface. Type 1b lesions are tears of the TFCC from its insertion into the distal ulna, either ligamentous avulsions from the fovea or fractures through the base of the ulnar styloid. Here, there is usually associated instability of DRUJ. Type 1c injuries involve the tear of volar ulnocarpal ligaments. These are high-energy injuries associated with DRUJ instability. Type 1d Lesions are detachments of the radial insertion of the TFCC with or without marginal sigmoid notch fractures. These are associated with DRUJ instability.

Pidgeon et al[33] in 2017 conducted a cadaveric study to find role of ulnar styloid base fractures in DRUJ instability. They evaluated DRUJ stability in prono-supination in 12 fresh-frozen upper extremities. They subjected each specimen to 3 N m of torque in both supination and pronation under 4 conditions: intact, ulnar styloid osteotomy with disruption of the foveal insertion of the DRUL, ulnar styloid fixation, and DRUL transection. They found that when compared with the intact condition, both ulnar styloid osteotomy and DRUL transection significantly increased mean pronation and supination of the forearm. Screw fixation only significantly reduced pronation compared with osteotomy. Screw fixation did not significantly affect supination. They concluded that ulnar styloid fractures that disrupt the fovea cause DRUJ instability.

Kim et al[34] in 2010 compared united and non-united fractures of the ulnar styloid following volar-plate fixation of distal radius fractures. The purpose of their study was to determine whether associated non-union of ulnar styloid fracture following ORIF of DRF has any effect on wrist functional outcomes, ulnar-sided wrist pain or distal radioulnar joint (DRUJ) instability. They found no significant differences at any time during follow-up between patients who achieved or did not achieve ulnar styloid fracture union or ulnar styloid base fracture union. They concluded that ulnar styloid non-union does not appear to affect wrist functional outcomes, ulnar-sided wrist pain or DRUJ stability, at least when a DRF is treated by open reduction and volar plate fixation.

Nakanishi et al in[35] 2013 studied DRUJ widening in radioulnar ligament tears: They analyzed fracture patterns and displacement in

the DRUJ using three-dimensional CT scans of intra-articular distal radius fractures. Of the 72 fractures analyzed, 8% had dorsal comminution and displacement of the DRUJ, which may increase the risk for DRUJ instability.

Experimentally, it is found that severely displaced DRF result in disruption of TFCC in the absence of ulna styloid fractures. USF through the base results in DRUJ instability if the fragment involves the foveal insertion of the TFCC. Similarly, fractures through the sigmoid notch produce stiffness and late onset arthritis of the DRUJ. The DRUJ can be injured in association with almost any fracture of the forearm or as an isolated phenomenon. Failure to recognize a simple or complex dislocation of the DRUJ associated with a fracture of the forearm may result in inappropriate or inadequate immobilization of the dislocated joint after internal fixation of the fracture. As a consequence, the injured TFCC may not heal, leading to recurrent postoperative instability.

Clinical presentation and diagnosis of fracture distal end radius with DRUJ injury: Patients most commonly complain of ulnar-sided wrist pain (USWP), especially on loading the hand and rotating the forearm, particularly following trauma, e.g., a fall on the outstretched hand (FOOSH). Patients can also complain of tenderness over the ulnar aspect of wrist, localized to the underlying anatomical structure.

Persistence of USWP and stiffness following distal radius fractures (DRF) point to DRUJ involvement. Clicking sounds, obvious instability, and weakness on lifting objects are also common complaints. Clinical tests to diagnose DRUJ injuries are:

Impingement test- It is done by supinating and pronating the ulnar deviated wrist with elbows resting at 90° on the table. Focal tenderness just distal to ulnar styloid is suggestive of TFCC tear, while that at the volar or dorsal margins of distal ulna head point to radioulnar ligament injury. Instability must be checked in different positions of supination and pronation.[1]

The *ulna fovea sign*- It is useful in detecting foveal disruptions and UT ligament injuries, which are two common causes of USWP. This is elicited by pressing the area between the flexor carpi ulnaris (FCU)

tendon and ulnar styloid, between the pisiform and volar margin of the ulna. The differentiation between these conditions can be made clinically, where UT ligament tears are typically associated with a stable DRUJ and foveal disruptions are typically associated with an unstable DRUJ.[36]

The *piano-key test*- It is positive when the ulna head is depressed volarly with the examiner's thumb and released, and it springs back like a piano key, suggesting instability.[1]

The *table top test-* It is done by asking the patient to press both hands on a flat table with forearm in pronation. With DRUJ instability, the ulna is more prominent dorsally and appears to sublux volarly with increasing pressure, creating a dorsal depression.[37]

The *grind test-* It is done by compressing the distal ulna and radius with the examiner's hand and producing a grinding motion, which elicits pain to suggest presence of DRUJ arthrosis.[1]

Radiographic investigations:

A standard posteroanterior (PA) and true lateral X-ray is mandatory. Potential radiographic predictors of DRUJ instability included three fracture characteristics: severity of the fracture pattern, an ulnar styloid fracture, and the magnitude of fracture displacement. X-rays can indicate a possibility of DRUJ instability. These include:[38,39]

1) Shortening of radius >5 mm relative to ulna
2) Fracture of the base of ulnar styloid
3) Widening of the DRUJ interval on PA view
4) Dislocation of the DRUJ on lateral view.

Omokawa et al[40] in 2014 studied radiographic predictors of DRUJ instability with DRF fixed with volar locking plates. Following fixation of the DRF, the surgeon manually examined the radioulnar ligament using the DRUJ ballottment test. They used five radiographic parameters to assess the magnitude of fracture displacement: ulnar variance, radial inclination, radial translation, volar tilt and sagittal translation. They concluded that a radiographic widening of DRUJ gap distance on a posteroanterior view was the most important predictor to identify DRUJ instability accompanying DRF.

Kasapinova et al[41] in 2016 studied the correlation of initial radiographic characteristics of distal radius fractures and injuries of the triangular fibrocartilage complex. In a prospective study, they included 85 patients with surgically treated distal radius fractures. The initial radial length and angulation, dorsal angulation, ulnar variance and distal radioulnar distance were measured. Wrist arthroscopy identified a triangular fibrocartilage complex lesion in 45 patients. They concluded that the initial radiograph of a distal radius fracture does not predict a triangular fibrocartilage complex injury.

Bessho et al[42] in 2018 conducted a cadaveric study to study the effect of decrease in radial inclination of distal radius fractures on DRUJ stability. They investigated the relationship between the radial inclination of the distal radius and DRUJ stability. They found that radial angulation deformities significantly increased DRUJ stiffness when the RUL is totally or partially attached to the ulnar fovea. After complete sectioning of the RUL, DRUJ stiffness decreased significantly; additional radial angulation deformity slightly increased DRUJ stiffness, but the DRUJ never recovered to the original stiffness. Based on the results, they concluded that radial angulation deformities of the distal radius should be corrected within 10 when the radioulnar ligament is intact, to reduce the risk of symptomatic DRUJ instability.

Ishikawa et al[43] in 2005 conducted a study on influence of DRUJ subluxation on restricted forearm rotation after distal radius fracture. They included twenty-two cases of healed unilateral distal radial fracture with restricted forearm rotation in the study. The subluxation of the DRUJ was evaluated using helical CT. The radiographic parameters of palmar tilt, radial inclination, dorsal shift, radial shift, and ulnar variance were measured on plain X-ray films and the rotational deformity of the distal radius was evaluated from the CT scan. They concluded that the subluxation of the DRUJ was related to restricted forearm rotation. The radiographic parameters of palmar tilt and ulnar variance showed an adverse influence on the position of the ulnar head at the DRUJ, which might lead to restricted forearm rotation after distal radial fracture.

Kwon et al[44] in 2012 conducted study of clinical and radiographic factors associated with distal radioulnar joint instability in distal radius fractures. They observed that distal radioulnar joint (DRUJ) instability is an important cause of ulnar-sided wrist pain in distal radius fractures. Widening of the DRUJ gap was identified as an independent risk factor for DRUJ instability in distal radius fractures. They concluded that an open wound and positive ulnar variance of 6 mm or greater on prereduction radiographs were risk factors of DRUJ instability in the setting of distal radius fractures.

Computed tomography is useful to delineate sigmoid notch fractures and DRUJ injuries. Ligament injuries can be assessed indirectly by assessing the radioulnar articulation in various positions and also by loading views. Normal views are taken in neutral, supination, and pronation. Subsequently, loaded views may be taken using weights held in the hand and the views repeated. The axial views of CT scan can provide information regarding subluxation and fractures of the ligamentous margins of radius and ulna. Three dimensional (3d) reconstructions are helpful in assessing spatial relationship between the radius and ulna.

Kim et al[45] in 2008 studied assessment of distal radioulnar joint instability after distal radius fracture with comparison of computed tomography and clinical examination results. They found that DRUJ instability diagnosed by the stress test and by CT showed no statistical correlation with radiographic parameters, but instability determined by CT appeared to be related to dorsal tilt deformity. They concluded that after distal radius fracture, CT assessments of DRUJ instability were found to be influenced by residual deformities, such as dorsal tilt, but not well correlated with stress test findings.

Magnetic resonance imaging (MRI) is useful for assessment of DRUJ ligaments. With a 3-T MRI, the radioulnar ligaments, ulnocarpal ligaments, and TFCC with its foveal attachment[46] to distal ulna can be adequately visualized with an 86% sensitivity for detection of TFCC tears.[47]

Bombaci et al[48] in 2006 conducted a prospective study of post-reduction magnetic resonance imaging (MRI) data for 60 consecutive patients with distal radius fractures to determine the radiographic predictors of a TFCC injury. They concluded that although there is no robust evidence on whether associated soft tissue injury affects clinical outcomes for treating wrist fractures, knowledge of the predictors of DRUJ instability is important.

Arthroscopy is the gold standard for evaluation of TFCC injuries.[49] The TFC, foveal attachment, the radioulnar ligament (RUL) and ulnar collateral (UC) ligaments are well visualized with ulnar portals. The volar and dorsal DRUJ portals also provide limited views of the structures. Arthroscopic debridement as well as repair of TFCC can be done.

Treatment of distal radio ulnar joint injuries associated with fracture distal radius is controversial: there is no single definitive treatment method that is considered the standard of care.

Treatment of DRUJ injuries

Treatment of TFCC injuries commences with non-operative measures such as splinting or AE cast, modification of activity, occupational therapy, and nonsteroidal anti-inflammatory drugs (NSAIDs). Steroid injections into the DRUJ may be tried. Gross instability or associated unstable ulnar styloid fractures warrants surgical intervention. Similarly, TFCC tears that fail to clinically improve following conservative care requires surgical treatment.

In 2012 Thomas et al[1] studied distal radio ulnar injuries. They concluded that the DRUJ injuries presents as ulna sided wrist pain resulting most commonly from traumatic episodes. Clinical examination provided information regarding the anatomical structures injured. Investigations helping in diagnosis include plain X-rays and MRI. Arthroscopy was considered the gold standard in diagnosis. Treatment include splinting, ORIF of fractures and repair of torn ligaments and TFCC by arthroscopy or open methods. They predicted DRUJ arthroplasty as emerging treatment in cases of arthrosis of the joint.

In 2015 Gong et al[50] studied surgical treatment of acute distal radioulnar joint instability associated with distal radius fractures. They evaluated 29 patients of mean age 53 years with a DRF and acute DRUJ instability who underwent volar plating of the radius combined with surgical repair of the TFCC or an ulnar styloid base fracture, followed by active motion exercise of the wrist at 1 week after surgery. At 1 year after treatment, all patients had a stable distal radioulnar joint and grip strength averaged 90% of the normal side. Their study demonstrates that surgical repair of the triangular fibrocartilage complex or ulnar styloid fracture followed by early mobilization did not result in distal radioulnar joint instability, and they suggested that the surgical treatment of distal radioulnar joint instability may permit early mobilization of the wrist in patients who are considered suitable for rapid rehabilitation after surgery.

In 2015 Fontes et al[51] studied pathology of the triangular fibrocartilaginous complex in distal radius fractures. They postulated that distal radius fracture is actually quite rarely isolated and TFCC is often involved with the same mechanism of injury. A contemporary management of the treatment of the initial fracture is ideal and so benefits from a routine arthroscopic management. Nevertheless, in the absence of diagnosis and therefore early treatment, the symptoms may be located at the ulnar crossroads and justify specific treatment of TFCC.

In 2017 Johandi et al[52] conducted a retrospective study evaluating clinical and functional outcome of open primary repair of triangular fibrocartilage complex tears associated with distal radius fractures, when there is gross intraoperative DRUJ instability after fixation of the distal radius, in the absence of an ulnar styloid fracture or when the ulnar fracture fragment is too small to be fixed. They concluded that a primary open repair of the TFCC should be considered when patients present with instability during intra-operative DRUJ ballottment test after distal radius fixation, in the absence of an ulnar styloid fracture or when the ulnar fracture fragment is too small to be fixed.

Kazemian et al[53] in 2011 studied about DRUJ instability after distal radius fracture with comparing cases with and without ulnar styloid fracture Their study was designed to assess the relationship between ulnar styloid fracture and the incidence of DRUJ instability after treatment of distal radius fractures treated with volar plating. Their study demonstrated that untreated stable or minimally displaced ulnar styloid fracture accompanied by distal radius fracture, has no adverse effect on DRUJ stability following volar plating of the radius.

In 2009 Sammer et al[54] studied the effect of ulnar styloid fractures on Patient-Rated Outcomes after volar locking plating of DRF**.** Between 2003 and 2008, a cohort of DRF patients treated with volar plating was enrolled. Patients with DRUJ instability treated at the time of distal radius ORIF were excluded. Patient-rated outcomes were measured postoperatively using the Michigan Hand Outcomes Questionnaire (MHQ). They concluded that in patients with a stable DRUJ after DRF ORIF ulnar styloid fractures did not affect subjective outcomes as measured by the MHQ.

In isolated DRUJ injuries most commonly TFCC is avulsed from its foveal insertion. The secondary stabilizers of the DRUJ including the IOM, UC ligaments, and ECU subsheath provide sufficient stability to prevent instability following healing. Closed manipulation and reduction under anaesthesia followed with immobilization of joint using splintage for 6 weeks may suffice. If failed or in severe TFCC injury arthroscopic repair may be needed.[31,55]

DRUJ with associated DRF

Assessment of DRUJ stability following DRF are best done intraoperatively after fixation of the radius fracture by translation of the ulna in a dorsopalmar direction. DRF with fracture of the dorsal or volar ulnar margins can be unstable as these include insertion of the dorsal or volar RUL. Similarly, sigmoid notch fractures, especially shearing type of fractures, produce instability due to involvement of TFC radial insertion. Therefore, it is necessary to include these fragments in the fixation of the DRF, either with the plate itself or with additional screws or K-wires. Fragment-specific fixation is helpful in

these situations. Unstable USF can be fixed by open reduction and tension band fixation, when associated with DRF.

Kim et al[56] in 2013 studied the effect of acute DRUJ laxity on outcome after volar plate fixation of DRF. They evaluated intraoperative DRUJ laxity using a radioulnar stress test after fixation of DRF using volar locking plate. Nineteen of the 84 study subjects were allocated to the unstable group and 65 to the stable group. No significant differences were observed between 2 groups in wrist range of motion, grip Strength, modified mayo wrist score, disabilities of arm, shoulder, hand score, visual analogue scale score, and ongoing pain in the DRUJ at 1 year postoperatively. They concluded that in patients treated with volar locking plate and immobilization of the forearm for 1 month in patients with Intraoperative laxity of the DRUJ, laxity did not affect impairment, pain, or disability 1 year after fracture.

Fujitani et al[38] in 2011 studied predictors of DRUJ instability in DRF. They treated 163 patients with unstable DRF with the volar locking plating system in which DRUJ instability was present in 11 of 163 DRF. They concluded that a radiographic finding of a normalized DRUJ gap on posteroanterior views was the most important predictor to identify DRUJ instability accompanying unstable DRF.

Dy et al[57] in 2014 studied the impact of coronal alignment on DRUJ stability following DRF. Their purpose was to test their hypothesis that coronal shift of the distal fragment would increase dorsal-volar DRUJ displacement in response to applied load. They concluded that in the setting of an ulnar styloid fracture, a 2-mm (but not a 4-mm) coronal shift of the DRF is associated with increased dorsal-volar DRUJ displacement in specimens with a distinct DOB, but not in specimens without a distinct DOB.

Liu J et al[58] in 2014 conducted a study questioning DRUJ fixation following volar plate fixation of DRF with unstable distal radioulnar joint. In their study, they demonstrated that following ORIF of distal radius with volar plates in patients with distal radius fractures, fixation of unstable DRUJs in neutral for six weeks does not have an advantage over non-fixation for a short period.

Postoperative assessment for functional outcome:

Evaluation of the outcome of a fracture or its treatment is essential to the practice of modern surgery, but any system used for this purpose must be reliable, reproducible, and validated. Initially, outcome measures for distal radius fracture concentrated on a combination of objective and subjective factors including pain, range of motion, grip strength, ability to undertake the activities of daily living, and radiologic measurements which mainly measure impairment. In recent years however, more emphasis has been placed on self-reported measures of symptoms and function after injury which measure perceived disability.

Clinician-Rated Outcome Measures: The most frequently used physician-based scores for distal radius fractures are the Mayo wrist score[59], the Modified Gartland and Werley score[60], and the Green and O'Brien score.[61]

Patient-Reported Outcome Measures: The Disabilities of Hand, Arm and Shoulder (DASH) Score[62], The Patient-Related Wrist Evaluation (PRWE) Score.[63]

Functional scoring according to **Modified Gartland and Werley Score:[60]**

I residual deformity

1. Prominent ulnar styloid	1
2. Residual dorsal tilt	2
3. Radial deviation of hand	2-3
Point range	0-3

II subjective evaluation

1. Excellent: no pain, disability or limitation of motion	0
2. Good: occasional pain, slight limitation of motion	2
3. Fair: occasional pain, some limitation of motion; Feeling of weakness in wrist, no particular disability if Careful, activities slightly restricted	4
4. Poor: pain, limitation of motion; disability, activities restricted	6
Point range	0-6

III objective evaluation:

1. Loss of dorsiflexion	5
2. Loss of ulnar deviation	3
3. Loss of supination	2
4. Loss of palmar flexion	1
5. Loss of radial deviation	1
6. Loss of circumduction	1
7. Loss of pronation	2
8. Pain in distal radioulnar joint	1
9. Grip strength-60% or less of opposite side	1
Point range	0-5

Iv complications

Arthritic change

1. Minimum	1
2. Minimum with pain	3
3. Moderate	2
4. Moderate with pain	4
5. Severe	3
6. Severe with pain	5
Nerve complication (median)	1-3
Point range	0-5

Vi. Total score

Excellent	0-2
Good	3-8
Fair	9-20
Poor	21 and above

Outcome: The final functional outcome is graded as excellent (score 0 to 2), Good (score 3 to 8), Fair (score 9 to 20) and poor (score 21 and above) as per the Modified Gartland and Werley scoring system.

MATERIALS AND METHODS

SOURCE OF DATA

It is a prospective study of patients with distal radius fractures managed with volar plating at Dayanand Medical College Ludhiana between January 2018 to May 2019 who were followed up till minimum of six months. Pre-operative assessment was done which included assessment of type of fracture, clinical and radiological assessment of distal radio-ulnar joint instability. Intraoperative assessment was done clinically (Piano key test/Ballotment test after distal radius fracture fixation). Post-operative assessment was done on basis of radiological (ulnar variance and dorsal/volar tilt) and Modified Gartland and Werley score.

METHOD OF COLLECTION OF DATA

Inclusion Criteria:

1. Patient age more than 18 years (skeletally mature patient)
2. Distal end radius fracture managed with volar plating

Exclusion Criteria:

1. Skeletally immature patient
2. Distal radius fracture managed conservatively by slab/cast/closed reduction and internal fixation with K-wires/ external fixator.

Pre-operative regimen

Following admission complete history, resuscitation, routine investigation, radiological investigation and pre-operative work up was noted regarding the occupation, date of injury, mode of injury, open or closed fracture, type of fracture, nature of distal radius fracture based on AO/OTA classification, intra-articular extension and distal radio-ulnar joint involvement. Radiological indices such as ulnar variance, radial height, widened DRUJ, dorsal/volar tilt, distal ulna fracture and associated injuries such as ulnar styloid fracture were noted. All patients were examined for deformity, swelling, tenderness, bony irregularities of distal radius and tenderness at ulnar styloid process were noted. Movements of the wrist and hand was evaluated. Pre-

anaesthetic checkup and consultation from suitable department were taken in case of other associated injuries or any co-existing co-morbidity. Patients were taken up for surgery after clearance from respective department in case of other associated injuries/comorbidities and anaesthesia team.

Preparation in the OT

Patients were placed on an operation table with radiolucent side support for injured upper limb to be operated. Patients were administered suitable anaesthesia (GA/Block) by anaesthesia team. Pneumatic tourniquet was used. The affected limb was cleaned using 10% povidone iodine and draped under all sterile precautions

Operative procedure

The styloid process of the radius was palpated. Then the tendon of flexor carpi radialis which was thick and immobile was palpated**.** 8-cm incision was made over the forearm between the radial artery and the flexor carpi radialis. The incision was carried to the sheath of the flexor carpi radialis. The sheath was opened and the forearm deep fascia was incised to expose the flexor pollicis longus. Index finger was placed into the wound and the flexor pollicis longus was swept gently ulnarly. The flexor pollicis longus muscle belly was partially detached from the radius to gain full exposure of the pronator quadratus. An L-shaped incision was given over the radial styloid along the radial border of the radius to expose the pronator quadratus and using a freer elevator it was elevated from the radius. The entire fracture line across the distal radius was then fully exposed. Fracture was reduced using small osteotome and distal traction over fingers under fluoroscopic guidance. Volar distal radius locking plate was placed and fixed with screws under fluoroscopic guidance. Distal radioulnar joint instability was checked intraoperatively by piano key / ballotment test and managed with K-wire stabilization. Wound was irrigated with normal saline. Closure was done layer by layer and aseptic dressing was done. Splintage was given if required by the postoperative construct.

Postoperative regimen

Postoperative X-rays of wrist were done in AP and lateral views to document the reduction of fracture and postoperative radiological indices for distal radius fractures. Postoperative surgical suture site care was done by regular aseptic dressings under cover of suitable antibiotics. Physiotherapy according to severity of fracture and postoperative reduction was initiated and patient was discharged accordingly. Patients were followed up in OPD at regular intervals. Postoperative assessment was done based on Modified Gartland and Werley score at 12 weeks and at last follow up (min 6 months) and X-rays at regular intervals. Any postoperative complication such as infection, deformity, angulation, distal ulnar sided pain, delayed/malunion, inadequate reduction and median nerve compression if present were noted. Final functional outcome was assessed according to Modified Gartland and Werley score and patients were categorized accordingly.

OUTCOME

The final functional outcome was graded as Excellent (Score 0 to 2), Good (Score 3 To 8), Fair (Score 9 to 20) and poor (Score 21 and above) and documented in the rating sheet as per the Modified Gartland and Werley scoring system.

STATISTICAL ANALYSIS

The data collected was recorded in a proforma and was analyzed using appropriate observational statistical methods. Obtained data was presented as a mean ± standard deviation, ranges, numbers and ratios according to requirement. Result were analysed using Chi-square test. Statistical analysis was conducted using the SPSS version 21 for windows statistical package. $P<0.05$ was considered statistically significant.

OBSERVATIONS AND RESULTS

During the time period from 1 January 2018 to 31 May 2019, 54 patients of distal radius fractures were treated with volar plate fixation. Out of these, four patients were skeletally immature and three patients were operated after 4 weeks of injury and were excluded. A total of 47 seven patients met the inclusion criteria and consented to be included in study. Out of these, two patients expired in the early postoperative period due to illness unrelated to injury and one patient was lost to follow up leaving 44 patients with 45 fractures in the final study group. One patient had ipsilateral brachial plexus injury which had not recovered at final follow-up, so results were not calculated for this patient.

Therefore we had a final follow up of 43 patients with 44 fractures for compilation of results and analysis. Of these 44 cases of volar plating, we had 12 patients with DRUJ instability (Axial or Anteroposterior or both) and 5 patients required stabilization with Kirshner wire.

Age incidence- In this study total 44 skeletally mature patients were analysed.

The patients included in this study ranged from 18 years to 77 years with mean age of 45.47 and standard deviation of 13.649. Five out of 44 patients were aged more than 60 years.

TABLE 1: AGE INCIDENCE

Age group	No. of cases	Percentage
< 30	6	13.3%
31-40	9	20.0%
41-50	15	35.6%
> 50	14	31.1%
Total	44	100.0%

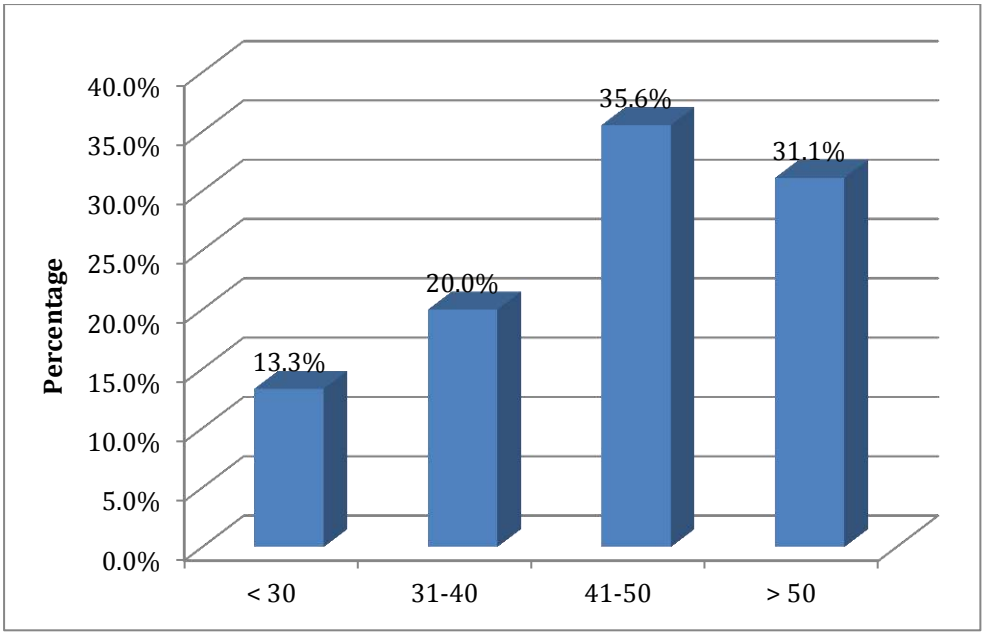

FIG 1: AGE INCIDENCE

Sex incidence- Of the 44 patients analysed 14 were females and 30 were male. Five of the female patients suffered from domestic fall and nine suffered from RTA. Five male patients suffered from domestic fall, one from fall from height and 24 males were involved in RTA. The males being more involved in road traffic accident can be reason for this observation.

TABLE 2: SEX INCIDENCE

SEX	No. of cases	Percentage
F	14	31.1%
M	30	68.9%
Total	44	100.0%

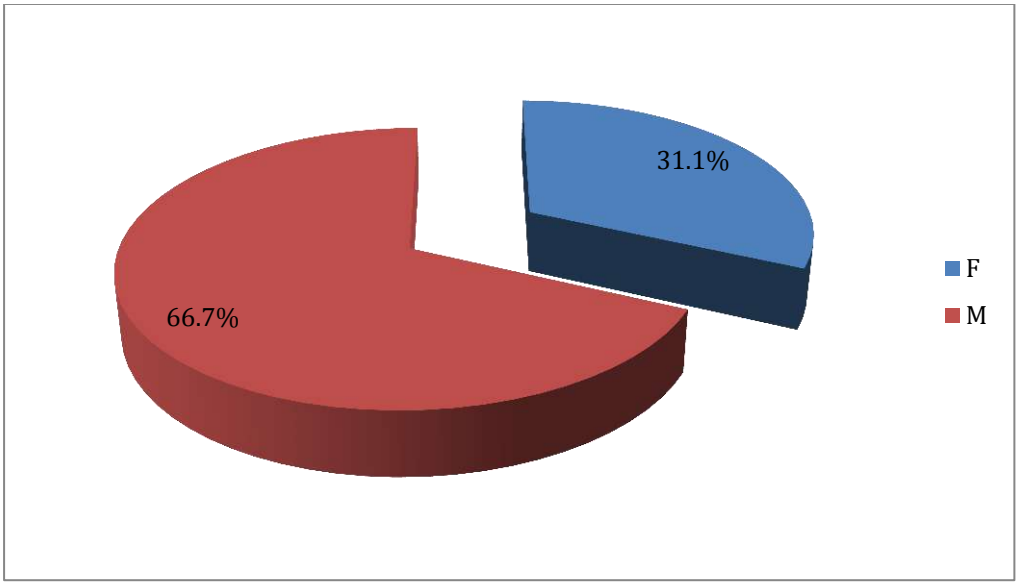

FIG 2: SEX INCIDENCE

Mode of injury:

Thirty three patients suffered this injury due to road traffic accident, 10 patients suffered domestic fall leading to this injury and 1 patient suffered from fall from height leading to fracture distal radius.

TABLE 3: MODE OF INJURY

MODE OF INJURY	No. of cases	Percentage
Domestic Fall	10	22.2%
Fall from height	1	2.2%
RTA	34	75.6%
Total	45	100.0%

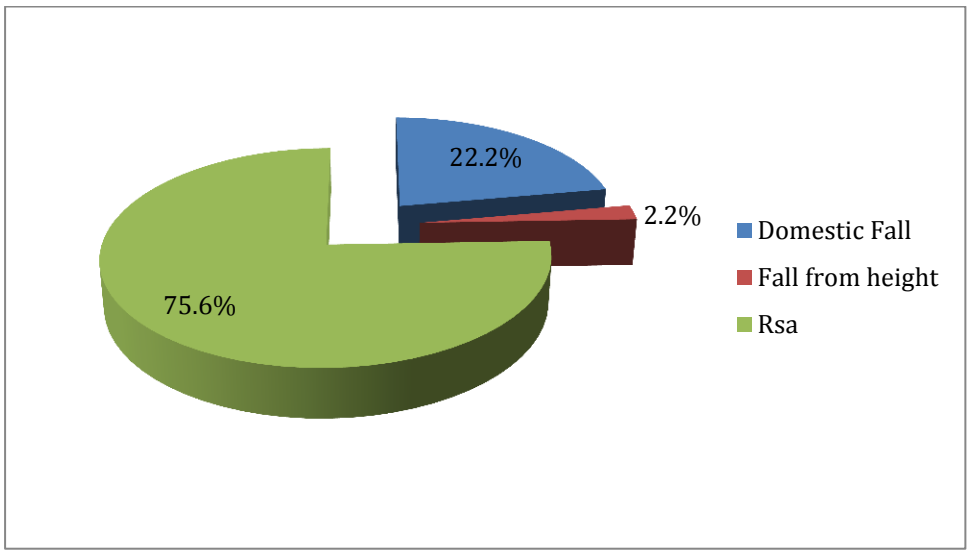

FIG 3: MODE OF INJURY

Hand dominance and injured side: Out of 45 fractures, right sided fracture distal radius was seen in 15 patients, left sided in 28 patients and one patient suffered from fracture distal radius bilaterally. We also evaluated hand dominance of patient and involvement of dominant/ non dominant hand in injury.

TABLE 4: INJURED SIDE

INJURED SIDE	No. of cases	Percentage
RIGHT	15	33.3%
LEFT	28	62.2%
BOTH	1	4.44%
TOTAL	45	100%

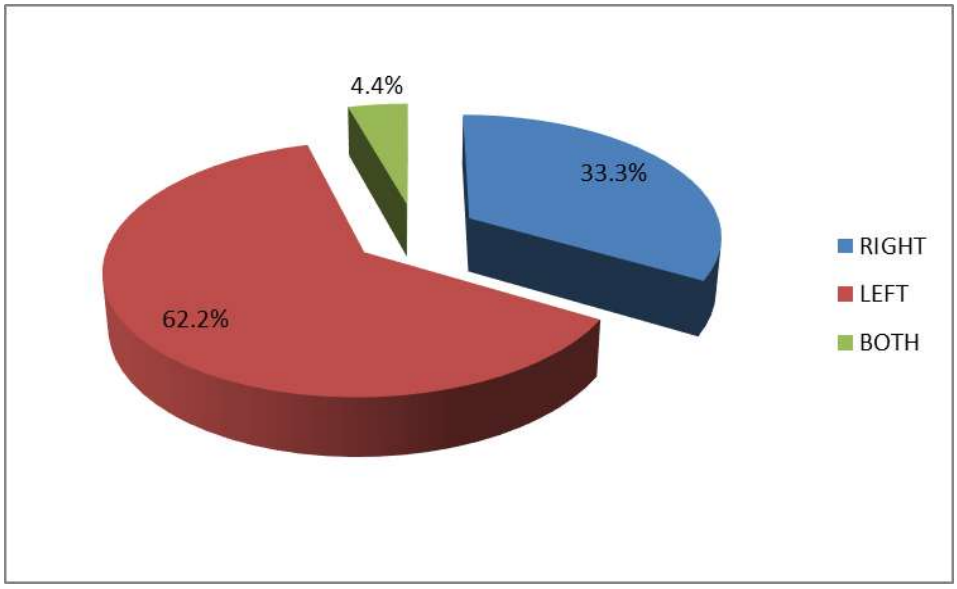

FIG 4: INJURED SIDE

TABLE 5: DOMINANCE OF INJURED HAND

INJURED HAND	No. of cases	Percentage
DOMINANT	14	31.1%
NON DOMINANT	31	68.9%
Total	45	100.0%

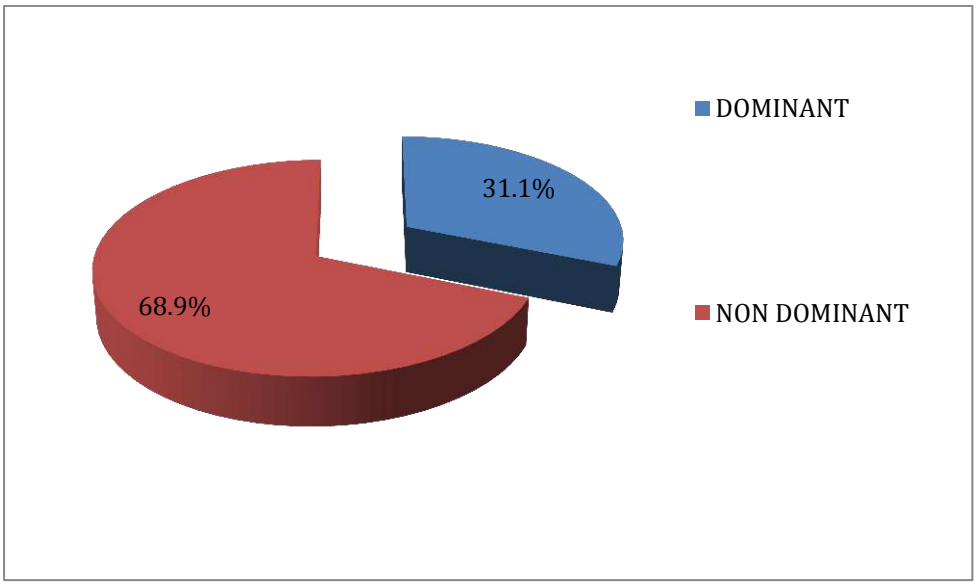

FIG 5: DOMINANCE OF INJURED HAND

OCCUPATION: We evaluated occupation of patients involved in this study and found following data.

TABLE 6: OCCUPATION

OCCUPATION	No. of cases	Percentage
Business	14	31.1%
Employee	14	31.1%
Farmer	4	8.9%
Housewife	10	22.2%
Student	3	6.7%
Total	45	100.0%

ASSOCIATED INJURIES

Most of our patients suffered from road traffic accident and we evaluated different associated injuries along with fracture distal radius and found following data:

TABLE 7: ASSOCIATED FRACTURES

OTHER ASSOCIATED FRACTURES	No. of cases	Percentage
Anterior shoulder dislocation right side	1	2.2%
B/l zygoma and maxilla fracture	1	2.2%
Bimalleolar fracture ankle	1	2.2%
Closed fracture 2nd metatarsal right side	1	2.2%
Closed fracture 3rd metacarpal right side	1	2.2%
Closed fracture lateral condyle femur right side	1	2.2%
Closed fracture proximal humerus right side	1	2.2%
Facial fractures	1	2.2%
Fracture distal ulna left side	1	2.2%
Fracture lumbar vertebrae	1	2.2%
Fracture radial head right side	1	2.2%
Ipsilateral 5th metacarpal fracture	1	2.2%
Ipsilateral fracture proximal humerus with brachial plexus injury, fracture distal ulna	1	2.2%
Ipsilateral fracture radial head and capitullum	1	2.2%
Ipsilateral proximal humerus fracture	1	2.2%
Lisfranc injury left foot	1	2.2%
No	25	55.6%
Open grade 2 fracture both bone leg right side	1	2.2%
Pelvic fracture	1	2.2%
Total	45	100.0%

ASSOCIATED IPSILATERAL UPPER LIMB INJURIES

We evaluated our patients for presence of ipsilateral upper limb injuries and found that four out of 44 patients suffered from ipsilateral upper limb injuries. One patient had ipsilateral proximal humerus fracture for which proximal humerus plating was done in separate sitting, one had ipsilateral fracture radial head and capitullum which was managed conservatively, one patient had ipsilateral fracture 5th metacarpal which was stabilized with K-wire in same sitting and one patient suffered from fracture proximal humerus with brachial plexus injury for which proximal humerus plating was done in separate sitting.

TABLE 8: ASSOCIATED IPSILATERAL UPPER LIMB INJURIES

IPSILATERAL	No. of cases	Percentage
YES	4	8.9%
NO	41	91.1%
Total	45	100.0%

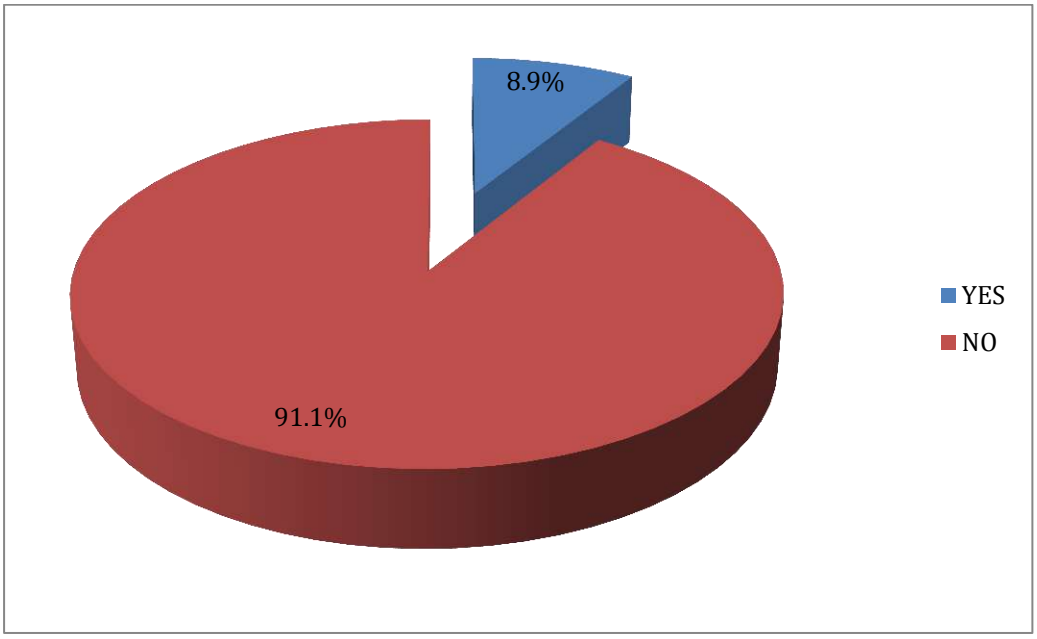

FIG 6: ASSOCIATED IPSILATERAL UPPER LIMB INJURIES

AVERAGE INTERVAL TO SURGERY

We evaluated average time interval in days from injury time to operation time in 45 cases which ranged from 0 (operated same day of injury) to maximum 18 days post injury with mean of 2.31 days and standard deviation of 3.3.

TABLE 9: AVERAGE INTERVAL TO SURGERY

AVERAGE INTERVAL TO SURGERY	No. of cases	Percentage
< 1	28	62.2%
2-4.0	12	26.7%
>4	5	11.1%
Total	45	100.0%

Follow up

All 45 cases were regularly followed up with range of follow up from 6 months to 22 months with mean of 11 months and standard deviation of 4.838 months.

TYPE OF FRACTURE

All fractures were classified as per Gustillo Anderson classification of open fractures. Forty three out of 45 cases were closed fractures and two cases were open fractures. No significant association between type of fracture and outcome was found (p value = 0.203).

TABLE 10: TYPE OF FRACTURE

TYPE OF FRACTURE	No. of cases	Percentage
Closed	43	95.6%
Open	2	4.4%
Total	45	100.0%

FRACTURE WITH INTRA ARTICULAR EXTENSION

Forty five fractures were evaluated on the basis of X-ray wrist AP and lateral view for intra-articular extension into radiocarpal joint. Twelve out of 45 cases were found to be extra-articular. In 33 patients fracture line was extending into radiocarpal joint and were intra-articular fractures.

TABLE 11: FRACTURE WITH INTRA ARTICULAR EXTENSION

Intra-articular extension	No. of cases	Percentage
No	12	26.7%
Yes	33	73.3%
Total	45	100.0%

NATURE OF DISTAL RADIUS FRACTURE BASED ON AO/OTA CLASSIFICATION

All the fractures were classified according to AO/OTA classification. Thirteen cases belong to 2R3A category of AO/OTA fracture classification, 12 were extra-articular distal radius fractures and one was radial styloid avulsion fracture. Seven cases belonged to 2R3B category of AO/OTA classification which are type of partial intraarticular fractures.

Twenty five cases were found to be of 2R3C type of AO/OTA classification which were intra articular and comminuted fractures. Most of the 2R3C type fractures were of road traffic accident cases. No significant association between nature of distal radius fracture and final outcome was found (p value = 0.617)

TABLE 12: NATURE OF DISTAL RADIUS FRACTURE

NATURE OF DISTAL RADIUS FRACTURE	No. of cases	Percentage
2R3C	24	54.5%
2R3A	13	29.6%
2R3B	7	15.9%
TOTAL	44	100.0%

TABLE 13: NATURE OF DISTAL RADIUS FRACTURE BASED ON AO/OTA CLASSIFICATION

NATURE OF DISTAL RADIUS FRACTURE	No. of cases	Percentage
2R3A1	1	2.2%
2R3A2-1	2	4.4%
2R3A2-2	7	15.6%
2R3A2-3	2	4.4%
2R3A3-3	1	2.2%
2R3B1-1	6	13.3%
2R3B3-1	1	2.2%
2R3C1-2	22	48.9%
2R3C2-1	1	2.2%
2R3C2-2	1	2.2%
2R3C3-1	1	2.2%
Total	45	100.0%

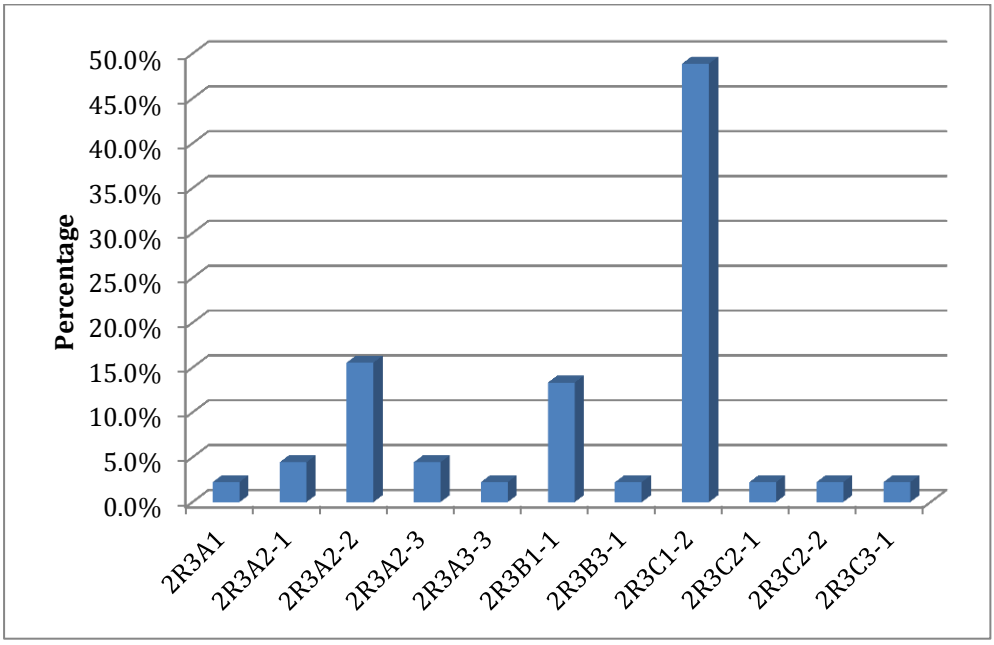

FIG 7: NATURE OF DISTAL RADIUS FRACTURE BASED ON AO/OTA CLASSIFICATION

TYPE OF ANAESTHESIA

After the pre-anaesthetic checkup, type of anaesthesia to be administered was decided by anaesthesia team. 14 out of 45 cases were administered general anaesthesia and 31 cases out of 45 were given regional block anaesthesia (supraclavicular brachial plexus block). No postoperative complication due to anaesthesia was found.

TABLE 14: TYPE OF ANAESTHESIA

GA / REGIONAL ANAESTHESIA	No. of cases	Percentage
GA	14	31.1%
RA	31	68.9%
Total	45	100.0%

TYPE OF IMPLANT

Two types of volar locking plates were used for distal radius fracture fixation. In 11 out of 45 cases fixed angle locking distal radius (LDRS) plates were used and in remaining 34 patients variable angle (VA) distal radius plates were used.

TABLE 15: TYPE OF IMPLANT

TYPE OF PLATE USED	No. of cases	Percentage
LDRS volar DER plate	11	24.4%
VA DER plate	34	75.6%
Total	45	100.0%

DRUJ INSTABILITY

We evaluated our patients for DRUJ instability based on both X-rays as well as clinical examination.

Ulnar variance was taken as the marker for axial instability. Ulnar variance was measured preoperatively from X-ray wrist AP view. Value of ulnar variance ranging from -2 to +2 mm was taken as normal. Axial instability was taken as ulnar variance less than -2 mm and more than +2 mm.

Thirty three out of 45 cases had normal ulnar variance while twelve out of 45 cases had axial instability with five cases having negative and seven cases having positive axial instability.

TABLE 16: AXIAL DRUJ INSTABILITY

AXIAL INSTABILITY	No. of cases	Percentage
NEGATIVE AXIAL INSTABILITY	5	11.1%
NO	33	73.3%
POSITIVE AXIAL INSTABILITY	7	15.6%
Total	45	100.0%

Piano key / ballotment test was taken as marker for Anteroposterior instability. Post volar plate fixation of fracture distal radius, piano key / ballotment test was done intraoperatively and we found piano key / ballotment test to be positive for five out of 45 cases. In these patients Anteroposterior instability was found to be positive and these patients were taken up for K-wire fixation of DRUJ joint.

TABLE 17: PIANO KEY TEST

PIANO KEY TEST	No. of cases	Percentage
Negative	40	88.9%
Positive	5	11.1%
Total	45	100.0%

After radiological and clinical assessment we found that axial DRUJ instability was found in eight of 45 fractures, one out of 45 fractures was having only Anteroposterior DRUJ instability and four out of 45 fractures were having both axial and Anteroposterior DRUJ instability. We found no significant relation between DRUJ instability status and outcome of fracture distal radius fixed with volar plating (p = 0.241).

TABLE 18: CORRELATION BETWEEN DRUJ INSTABILITY STATUS AND POST OPERATIVE ASSESSMENT

POST OPERATIVE ASSESSMENT				Total			Chi-square value	p-value
		Excellent	Fair	Good	Poor			
DRUJ INSTABILITY STATUS	AXIAL INSTABILITY	1	2	4	1	8	11.535	0.241
	BOTH	0	1	1	1	3		
	NO	9	4	18	1	32		
	ANTERO-POSTERIOR INSTABILITY	0	1	0	0	1		
Total		10	8	23	3	44		

We analysed correlation between abnormal ulnar variance i.e. axial instability and piano key test i.e. anteroposterior stability and found significant relation between these two. (p= 0.008)

TABLE 19: CORRELATION BETWEEN ABNORMAL ULNAR VARIANCE AND PIANO KEY TEST

AXIAL INSTABILITY	PIANO KEY TEST		Total	Chi-square value	p-value
	Negative	Positive			
NEGATIVE AXIAL INSTABILITY	4	1	5	9.725	0.008
POSITIVE AXIAL INSTABILITY	4	3	7		
NO	32	1	33		
Total	40	5	45		

ULNAR STYLOID FRACTURE

We evaluated 45 fractures and found 29 out of 45 fractures were having associated ulnar styloid (US) fractures and 16 out of 45 fractures distal radius had intact ulnar styloid. Seven out of twenty nine ulnar styloid fractures were ulnar styloid base fractures. Significant association was found between ulnar styloid base fractures and final outcome (p = 0.023). No significant association was found between ulnar styloid fractures and final outcome (p = 0.357).

TABLE 20: ULNAR STYLOID FRACTURE TYPE

ULNAR STYLOID FRACTURE TYPE	No. of cases	Percentage
NO	16	35.6%
US BASE FRACTURE	7	15.6%
US FRACTURE OTHERS	22	48.9%
Total	45	100.0%

TABLE 21: CORRELATION BETWEEN ULNAR STYLOID BASE FRACTURE AND POST OPERATIVE ASSESSMENT

POST OPERATIVE ASSESSMENT	ULNAR BASE FRACTURE		Total	Chi-square value	p-value
	NO	YES			
Excellent	10	0	10	9.55	0.023
Fair	4	4	8		
Good	20	3	23		
Poor	3	0	3		
Total	37	7	44		

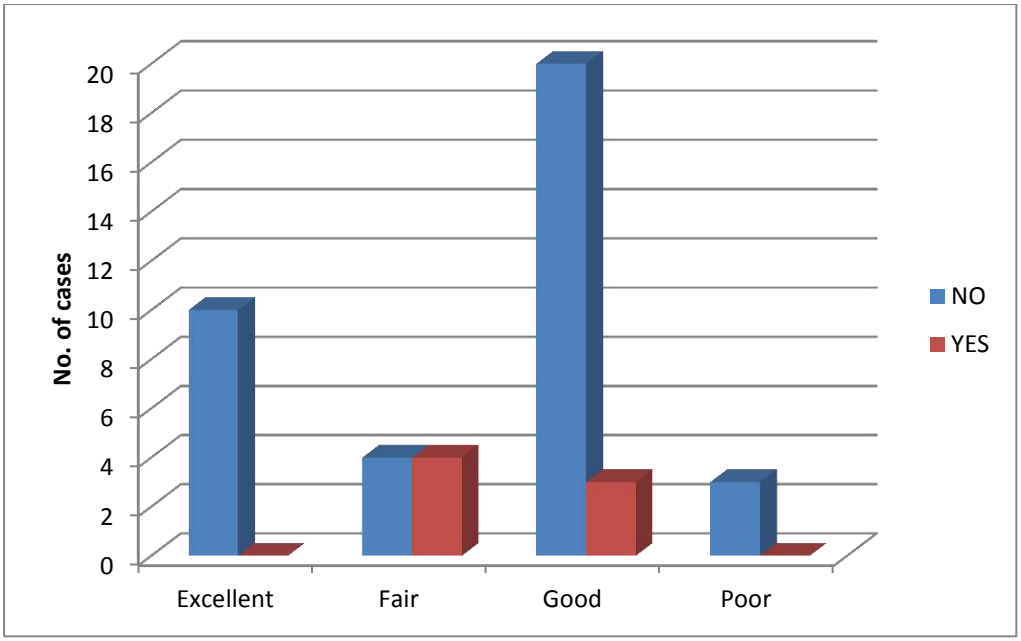

FIG 8: CORRELATION BETWEEN ULNAR STYLOID BASE FRACTURE AND POST OPERATIVE ASSESSMENT

POSTOPERATIVE ASSESSMENT

Postoperative assessment was done on basis of Modified Gartland and Werley score at final follow up. Based on final score cases were divided into excellent (score 0 to 2), good (score 3 to 8), fair (score 9 to 20) and poor (score 21 and above). Score ranged from 1 to 24 with mean value of 6.09 with standard deviation of 5.36.

TABLE 22: POSTOPERATIVE ASSESSMENT

POST OPERATIVE ASSESSMENT	No. of cases	Percentage
Excellent	10	22.7%
Good	23	52.3%
Fair	8	18.2%
Poor	3	6.8%
Total	44	100.0%

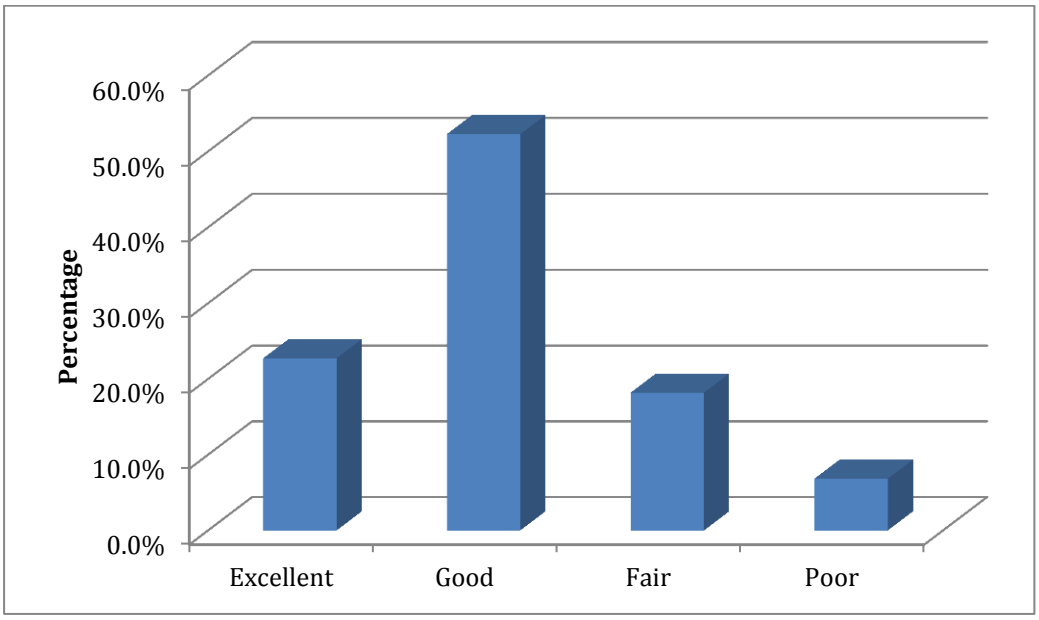

FIG 9: POSTOPERATIVE ASSESSMENT

Out of 45 cases evaluated for final follow up 13 patients i.e. 28.9% suffered from loss of dorsiflexion

TABLE 23: LOSS OF DORSIFLEXION

LOSS OF DORSIFLEXION	No. of cases	Percentage
NO	32	71.1%
YES	13	28.9%
Total	45	100.0%

COMPLICATIONS

We studied our patients for postoperative complications upto final follow up and found that seven out of forty four cases suffered from distal ulnar sided pain, three patients were found to have inadequate reduction in postoperative X-rays and one patient suffered from transient median nerve compression. All fractures united and there was no postoperative, deformity or angulation in any patient.

TABLE 24: COMPLICATIONS

	No. of cases	Percentage
INFECTION	0	0.0%
DEFORMITY	0	0.0%
ANGULATION	0	0.0%
DISTAL ULNAR SIDED PAIN	7	15.6%
DELAYED UNION/NON UNION	0	0.0%
INADEQUATE REDUCTION	3	6.7%
TRANSIENT MEDIAN NERVE COMPRESSION	1	2.2%

DISCUSSION

In the present study we had final follow up of 43 patients with 44 fractures for compilation of results.

Age incidence

In our study fractures of distal radius were found to be more common in middle age population with mean age of 45.5 years ranging from 18 to 77 years. The higher incidence of this age group in our study could be attributed to age related effect of decreased bone mineral density on quality of bones and high incidence of road traffic accidents in that age group.

Kim et al[56] in 2013 reported similar trend in their study with mean age of 45 years ranging from 18 to 60 years.

Kim et al[34] in 2010 reported similar trend in their study with mean age of 50 years ranging from 18 to 88 years.

Kilic et al[25] in 2009 reported similar trend in their study with mean age of 45 years ranging from 18 to 77 years.

Tarallo et al[64] in 2013 reported similar trends in their study with mean age of 56 ranging from 18 years to 87 years.

Sex incidence

In our study of fracture of distal radius fourteen of our cases were females and thirty were males. The higher incidence of our male in our study could be attributed to the fact that in our country males are more commonly involved in outdoor activities making them at a higher risk of road traffic accidents.

Kim et al[45] in 2008 reported similar trend in their study where twenty three out of thirty four patients were males and eleven out of thirty patients were females.

Kazemian et al[53] in 2011 reported similar trends in their study where out of 86 patients 59 were males and 27 patients were females.

Mode of injury

Most of our cases (31) suffered from this injury due to road traffic accident. Ten cases of distal radius fractures were due to domestic

falls and one case was due to fall from height. Increasing incidence of road traffic accidents can be attributed for this finding.

Kwon et al[44] in their study of 221 patients reported one hundred forty-six distal radius fractures occurred after a fall from a standing height, 33 fractures occurred from a fall at a height greater than 1 m, 28 fractures occurred from sports-related activities, and 14 fractures were caused by traffic accidents.

Gustillo Anderson fracture classification and AO/OTA classification

In this study majority of fractures i.e. 43 of 44 were closed fracture distal radius. One case was of open fracture grade I. On classifying these fractures according to AO/OTA classification, twenty four out of forty four cases were type C, thirteen were of type A and seven cases were of type B. Maximum no. of cases (22) belonged to C1-2 type. High incidence of type C type fracture indicates high energy trauma due to road traffic accidents as mode of injury.

Kim et al[56] in 2013 in their study divided their 84 patients for study into AO/OTA classification and recorded similar trends. 44 of their patients were of type C, 20 belonged to type B and 20 patients were classified under type A.

Sammer et al[54] in 2009 classified their study patients into AO/OTA classification and found 73 patients belonging to type A, 16 patients belonged to type B and 55 patients were of type C category.

Kwon et al[44] in 2012 studied 221 patients and found that, According to AO/OTA classification , 43 fractures were Type A3, four were Type B1, 13 were Type B2, 45 were Type C1, 52 were Type C2, and 64 were Type C3. There were 18 open fractures.

Ulnar styloid fracture

We evaluated 44 fractures and found twenty nine out of forty four fractures were having associated ulnar styloid fractures and fifteen out of forty four fractures distal radius had intact ulnar styloid. Seven out of twenty nine ulnar styloid fractures were ulnar styloid base fractures. Significant association was found between ulnar styloid base fractures

and final outcome (p = 0.023). No significant association was found between ulnar styloid fractures and final outcome (p = 0.357)

We found in our study that stable ulnar styloid tip fracture does not effect outcome in management of DRF managed with locking plates whereas ulnar styloid base fractures which include fovea where TFC complex is attached will result in DRUJ instability and negatively impact outcome of DRF fixed with volar plating. Ulnar base fracture should be examined for DRUJ instability and fixed if needed.

Stoffelan et al[29] in 1998 conducted a study on distal radius fractures and found that ulnar styloid fracture has negative effect on outcome as tested by instability tests.

Pidgeon et al[33] in 2017 conducted a cadaveric study to find role of ulnar styloid base fractures in DRUJ instability. They found that when compared with the intact condition, both ulnar styloid osteotomy and DRUL transection significantly increased mean pronation and supination of the forearm. They concluded that ulnar styloid fractures that disrupt the fovea cause DRUJ instability.

May et al[65] in 2002 reported that fractures at the base of the ulnar styloid and major displacement of an ulnar styloid fracture were both found to increase the risk of DRUJ instability.

Kim et al[34] in 2010 compared united and non-united fractures of the ulnar styloid following volar-plate fixation of distal radius fractures. They concluded that ulnar styloid non-union does not appear to affect wrist functional outcomes, ulnar-sided wrist pain or DRUJ stability, at least when a DRF is treated by open reduction and volar plate fixation.

DRUJ instability

We evaluated our patients for DRUJ instability in axial and anteroposterior planes. Ulnar variance was used as marker of axial DRUJ instability and piano key test was taken as marker for anteroposterior instability

After radiological and clinical assessment we found that axial DRUJ instability was found in eight of 45 fractures, one out of 45 fractures was having antero-posterior DRUJ instability and four out of 45 fractures were having both axial and antero-posterior DRUJ instability.

We found no significant relation between DRUJ instability status and outcome of fracture distal radius fixed with volar plating. (p = 0.241)

We analysed correlation between abnormal ulnar variance i.e. axial instability and piano key test i.e. anteroposterior stability and found significant relation between these two. (p= 0.008). We conclude that ulnar variance is a good marker to check for instability in the AP plane by ballotment test.

Dario et al[11] in 2014 conducted a study to find the necessity to restore radial anatomic parameters after distal radius fractures. They concluded that ulnar variance and volar tilt are the most important radiographic parameters to be restored to obtain good functional outcome in distal radius fracture.

Lindau et al[28] in 2000 studied effect of DRUJ instability on outcome of DRF. They assessed 76 young patient for 1 year. They found that instability at clinical examination of the DRUJ was associated with a worse wrist score and doubled the visual analogue measures for pain at rest and pain at load. They concluded that distal radioulnar instability is an independent worsening factor in distal radial fractures.

Ishikawa j et al[43] in 2005 conducted a study on influence of DRUJ subluxation on restricted forearm rotation after distal radius fracture. They included twenty-two cases of healed unilateral distal radial fracture with restricted forearm rotation in the study. They concluded that radiographic parameters of palmar tilt and ulnar variance showing DRUJ instability might lead to restricted forearm rotation after distal radial fracture.

POSTOPERATIVE ASSESSMENT

Postoperative assessment was done on basis of Modified Gartland and Werley score at final follow up. Score ranged from 1 to 24 with mean value of 6.09 with standard deviation of 5.36. Out of 44 cases for final evaluation, ten cases i.e. 22.7% were evaluated as excellent, 23 cases i.e. 62.3% were found to be in good outcome, eight cases i.e. 18.2% were evaluated as fair and three i.e. 6.8 % patients had poor functional outcome. Out of 45 cases evaluated for final follow up 13 patients i.e. 28.9% suffered from loss of dorsiflexion which may be attributed to

high incidence of intra-articular fractures i.e. 33 out of 45 fractures (73.3%).

Kilic et al[25] in 2009 conducted a study to evaluate radiographic and functional results of volar locking plate fixation of unstable distal radius fractures. Their study included 27 patients (15 males, 12 females; mean age 45 years; range 18 to 77 years) who were treated with volar locking plate fixation for unstable DRF. According to the Modified Gartland and Werley scale, the results were excellent in 12 patients (44.4%), good in 12 patients, and moderate in three patients (11.1%). Their mean follow-up was 18 months (range 12 to 34 months). They concluded volar locking plate fixation is an effective treatment in the anatomical and functional restoration of unstable distal radius fractures. We found in this study that it is important to recognise DRUJ instability both in axial and anteroposterior planes while assessing DRF. Both clinical and radiological parameters need to be assessed to detect DRUJ involvement. Ulnar variance is a good marker to check for instability in the AP plane by ballotment test.

Locking plates offer excellent restoration of structural anatomy of distal radius as well as DRUJ anatomy combined with K-wire fixation of DRUJ. It offers a high proportion of good and excellent results even in high energy trauma.

Limitation of this study

- Ulnar variance may not be properly assessed in preoperative X-rays due to improper positioning
- Interobserver variation may occur in assessing DRUJ instability by different operating surgeons.
- Our patient cohort is relatively small in size with no control group, so large multicentric studies with control group will shed more light on this problem.

SUMMARY AND CONCLUSION

The aim of this study was to study the effect of distal radioulnar joint (DRUJ) involvement on outcome of distal radius fractures. This study had total of 44 patients with 45 fractures of distal radius which were fixed with volar plating. The age ranged widely from 18 to 77 years with mean age of 45 years. Majority of these patients belonged to 41-50 years age group with male preponderance. Road traffic accidents (34 fractures, 75.6%) were the most common cause of these fractures followed by domestic fall (10 fractures, 22.2%).

We had final follow up of 44 cases for compilation of results and analysis. After radiological and clinical assessment, we found that axial DRUJ instability was found in eight of 45 fractures, one out of 45 fractures was having anteroposterior DRUJ instability and four out of 45 fractures were having both axial and anteroposterior DRUJ instability. One patient had ipsilateral brachial plexus injury which had not recovered at final follow-up, so results were not calculated for this patient.

Thirty-one of fractures in our study were of non-dominant hand and 14 were of dominant hand. This may be attributed due to high incidence of road traffic accident as causative agent rather than domestic fall.

Twelve out of 45 cases were found to be extra-articular. In 33 patients fracture line was extending into radiocarpal joint and were intra-articular fractures.

All the fractures were classified according to AO/OTA classification. Thirteen cases belonged to 2R3A category, seven cases belonged to 2R3B category and twenty five cases were found to be of 2R3C category of AO/OTA classification. Most of the 2R3C type fractures were of road traffic accident cases. No significant association between nature of distal radius fracture and final outcome was found, which may be due to good restoration of structural anatomy of distal radius as well as DRUJ by locked plating.

In all 45 cases locking volar plates were used. In 11 out of 45 cases fixed angle locking distal radius (LDRS) plates were used and in

remaining 34 patients variable angle (VA) distal radius plates were used. Locking plates offer excellent restoration of structural anatomy of distal radius as well as DRUJ anatomy. Combined with K-wire fixation of DRUJ, it offers a high proportion of good and excellent results even in high energy trauma.

After radiological and clinical assessment, we found that axial DRUJ instability was found in eight of 45 fractures, one out of 45 fractures was having only Anteroposterior DRUJ instability and four out of 45 fractures were having both Axial and Anteroposterior DRUJ instability. We found no significant relation between DRUJ instability status and outcome of fracture distal radius fixed with volar plating.

We analysed correlation between abnormal ulnar variance i.e. Axial instability and piano key test i.e. Anteroposterior stability and found significant relation between these two. (p= 0.008). We conclude that ulnar variance is a good marker to check for instability in the AP plane by ballotment test.

We evaluated 45 fractures and found 29 out of 45 fractures were having associated ulnar styloid (US) fractures and 16 out of 45 fractures distal radius had intact ulnar styloid. Seven out of twenty-nine ulnar styloid fractures were ulnar styloid base fractures. Significant association was found between ulnar styloid base fractures and final outcome (p = 0.023). No significant association was found between ulnar styloid fractures and final outcome (p = 0.357). We conclude that stable ulnar styloid tip fracture does not effect outcome in management of DRF managed with locking plates whereas ulnar styloid base fractures which include fovea where TFC complex is attached will result in DRUJ instability and negatively impact outcome of DRF fixed with volar plating. Ulnar base fracture should be examined for DRUJ instability and fixed if needed.

Postoperative assessment was done on basis of Modified Gartland and Werley score at final follow up. Score ranged from 1 to 24 with mean value of 6.09 with standard deviation of 5.36. Out of 44 cases for final evaluation, ten cases i.e. 22.7% were evaluated as excellent, 23 cases i.e. 62.3% were found to be in good outcome, eight cases i.e. 18.2%

were evaluated as fair and three i.e. 6.8% patients had poor functional outcome. This may be attributed to locking plates which offer excellent restoration of structural anatomy of distal radius as well as DRUJ anatomy combined with K-wire fixation of DRUJ. It offers a high proportion of good and excellent results even in high energy trauma.

Out of 45 cases evaluated for final follow up 13 patients i.e. 28.9% suffered from loss of dorsiflexion which may be attributed to high incidence of intra-articular fractures i.e. 33 out of 45 fractures (73.3%)

CONCLUSION

Thus, to conclude, it is important to recognise DRUJ instability both in axial and anteroposterior planes while assessing DRF. Both clinical and radiological parameters needs to be assessed to detect DRUJ involvement. Ulnar variance is a good marker to check for instability in the AP plane by ballotment test. Ulnar styloid fracture that are stable and ulnar styloid tip fracture does not effect outcome in management of DRF managed with locking plates whereas ulnar styloid base fractures which include fovea where TFC complex is attached will result in DRUJ instability and negatively impact outcome of DRF fixed with volar plating. Ulnar base fracture should be examined for DRUJ instability and fixed if needed.

Locking plates offer excellent restoration of structural anatomy of distal radius as well as DRUJ anatomy. Combined with K-wire fixation of DRUJ. It offers a high proportion of good and excellent results even in high energy trauma.

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X-RAY PRE- OP FRACTURE DISTAL RADIUS WITH DRUJ INJURY (PT SN. 23)

SURGEON PERFORMING PIANO KEY/ BALLOTMENT TEST INTRA-OPERATIVELY (PT SN 23)

POST OP X-RAY VOLAR LOCKING PLATE FIXATION DRF WITH K-WIRE STABLIZATION DRUJ (PT SN 23)

FINAL FOLLOW UP X-RAY AFTER K-WIRE REMOVAL(PT SN 23)

DORSIFLEXION AND PALMER FLEXION (PT SN 23)

SUPINATION AND PRONATION (PT SN 23)

ULNAR DEVIATION AND RADIAL DEVIATION (PT SN 23)

PREOP X-RAY DISTAL RADIUS FRACTURE (PT SN 20)

POSTOP XRAY DRF VOLAR PLATE FIXATION (PT SN 20)

FOLLOW UP XRAY (PT SN 20)

RANGE OF MOTION AT DRUJ- SUPINATION AND PRONATION(PT SN 20)

DORSIFLEXION AND PALMAR-FLEXION (PT SN 20)

RADIAL AND ULNAR DEVIATION (PT SN 20)

PRE OP X-RAY INTRAARTICULAR FRACTURE DISTAL RADIUS WITH FRACTURE ULNAR STYLOID (PT SN 17)

POST OP X-RAY DRF AFTER VOLAR PLATE FIXATION (PT SN 17)

LAST FOLLOW UP X-RAY (PT SN 17)

DORSIFLEXION AND PALMERFLEXION AT WRIST JOINT (PT SN 17)

SUPINATION AND PRONATION AT DISTAL RADIO ULNAR JOINT(PT SN 17)

ULNAR DEVIATION AND RADIAL DEVIATION (PT SN 17)

PREOP XRAY INTRA-ARTICULAR FRACTURE DISTAL RADIUS (PT SN 13)

POST OP X-RAY AFTER VOLAR PLATING(PT SN 13)

FINAL FOLLOW UP XRAY (PT SN 13)

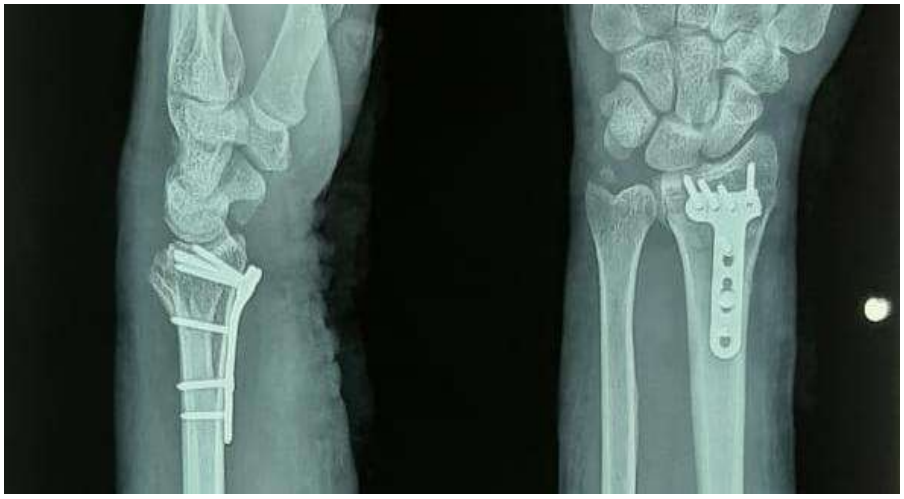
DORSIFLEXION AND PALMARFLEXION (PT SN 13)

SUPINATION AND PRONATION (PT SN 13)

RADIAL AND ULNAR DEVIATION (PT SN 13)

PREOP X-RAY FRACTURE DISTAL RADIUS(PT SN 33)

POSTOP XRAY (PT SN 33)



FINAL FOLLOW UP XRAY (PT SN 33)

DORSIFLEXION AND PALMARFLEXION (PT SN 33)

SUPINATION AND PRONATION (PT SN 33)

SURGICAL SCAR MARK (PT SN 33

PREOP X-RAY FRACTURE DISTAL RADIUS(PT SN 42)

POSTOP X-RAY AFTER VOLAR PLATING (PT SN 42)

LAST FOLLOW UP XRAY (PT SN 42)

DORSIFLEXION AND PALMARFLEXION (PT SN 42)

SUPINATION AND PRONATION (PT SN 42)

ULNAR AND RADIAL DEVIOATION (PT SN 42)

PRE OP XRAY FRACTURE DISTAL RADIUS (PT SN 21)

POST OP XRAY AFTER VOLAR PLATING (PT SN 21)

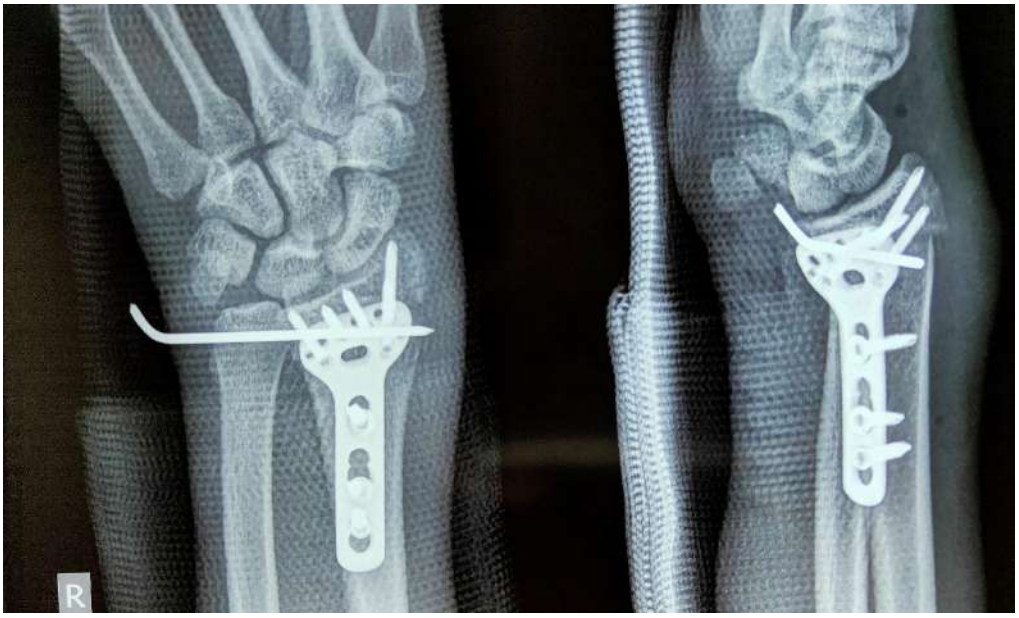
LAST FOLLOW UP XRAY (PT SN 21)

DORSIFLEXION AND PALMARFLEXION (PT SN 21)

SUPINATION AND PRIONATION (PT SN 21)

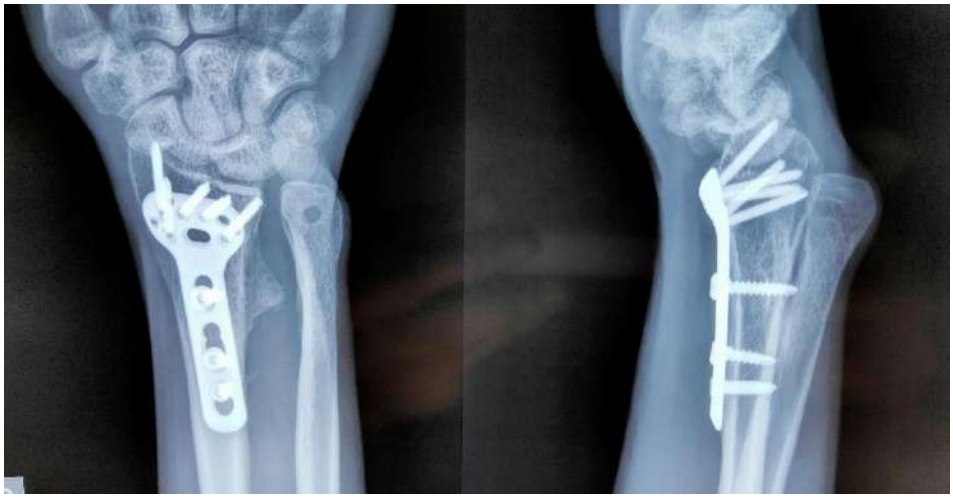
POST OP RESIDUAL DEFORMITY (PT SN 37)

POSTOP XRAY VOLAR PLATE FIXATION DISTAL RADIUS WITH DRUJ STABILIZATION WITH K-WIRE (PT SN 37)



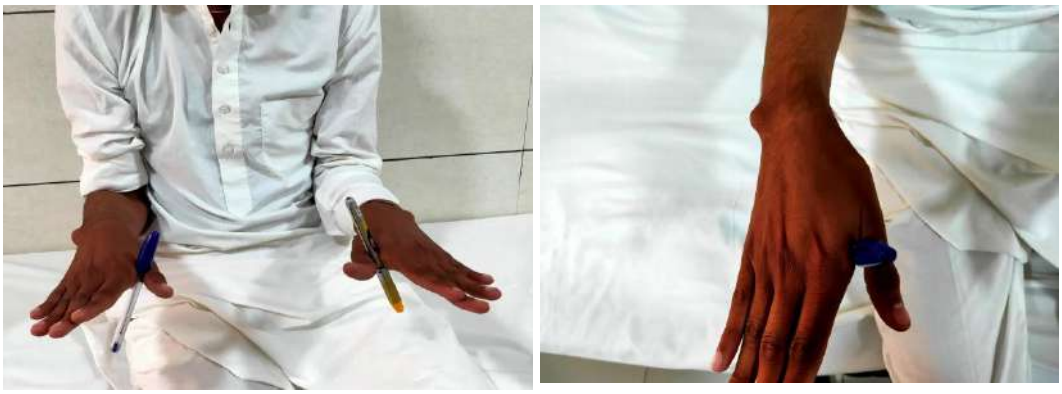
POST OP XRAY AFTER K-WIRE REMOVAL(PT SN 37)

XRAY LAST FOLLOW UP (PT SN 37



LOSS OF DOTRSIFLEXION AND PALMARFLEXION (PT SN 37)

SUPINATION AND PRONATION (PT SN 37)



S.NO	NAME	CR/MRD No	AGE (Year)	SEX	OCCUPATION	AVERAGE INTERVAL TO SURGERY	FOLLOW UP DURATION(DAYS	HAND DOMINANCE	INJURED HAND	MODE OF INJURY	OTHER ASSOCIATED FRACTURES	TYPE OF FRACTURE (CLOSED/OPEN GRADE I / II / III a / IIIb)	INTRA-ARTICULAR EXTENSION
1	AG	214881	31	M	Business	11	664	Right	NON DOMINANT	Rsa	No	Closed	Yes
2	RS	427052	43	F	housewife	1	621	Right	NON DOMINANT	Rsa	No	Closed	Yes
3	HC	438969	57	M	Business	4	621	Right	NON DOMINANT	Domestic fall	Closed fracture lateral condyle femur right side	Closed	No
4	BK	432163	50	F	housewife	1	188	Right	NON DOMINANT	Rsa	Open grade2 fracture both bone leg right side	Closed	No
5	SG	445057	55	F	Housewife	1	252	Right	DOMINANT	Rsa	No	Closed	Yes
6	MP	389882	57	F	pvt job	3	471	Right	NON DOMINANT	Domestic fall	No	Closed	No
7	SK	525616	41	M	Business	1	198	Right	DOMINANT	Rsa	No	Closed	Yes
8	VK	511476	30	m	Business	1	523	Right	NON DOMINANT	Rsa	No	Closed	Yes
9	KR	529837	72	F	housewife	4	487	Right	NON DOMINANT	Rsa	IPSILATERAL PROXIMAL HUMERUS FRACTURE	Closed	Yes
10	SK	559561	27	M	Business	6	472	Right	NON DOMINANT	Rsa	No	Closed	Yes
11	DS	578465	45	m	business	0	344	Right	NON DOMINANT	Rsa	Closed fracture 3 rd metacarpal right side	Closed	No
12	GA	76264	41	F	pvt job	1	351	Right	NON DOMINANT	Rsa	No	Closed	Yes
13	GS	211599	49	m	dmc employee	1	403	Right	NON DOMINANT	Rsa	Anterior shoulder dislocation right side	Closed	Yes
14	NJ	596934	65	f	housewife	0	298	Right	DOMINANT	Rsa	No	Closed	Yes
15	SS	597774	47	m	business	8	253	Right	NON DOMINANT	Rsa	IPSILATERAL 5TH METACARPAL FRACTURE	Closed	Yes
16	DS	613270	27	m	pvt job	1	370	Right	NON DOMINANT	Rsa	No	Closed	No
17	TL	3881	45	m	dmc employee	1	309	Right	NON DOMINANT	Rsa	No	Closed	Yes
18	VK	633379	46	m	pvt job	4	249	Right	NON DOMINANT	Domestic fall	No	Closed	Yes
19	KS	677289	34	m	farmer	3	192	Right	DOMINANT	Rsa	Closed fracture 2nd metatarsal right side	Closed	No
20	SJ	685926	35	f	housewife	2	603	Right	DOMINANT	Domestic fall	No	Closed	Yes
21	RK	684389	46	m	Business	1	214	Right	DOMINANT	Rsa	No	Closed	Yes
22	CK	677267	40	f	housewife	2	254	Right	DOMINANT	Rsa	B/l zygoma and maxilla fracture	Closed	No
23	SA	733111	22	m	student	1	199	Right	NON DOMINANT	Rsa	No	Closed	Yes
24	AS	713837	18	m	student	0	191	Right	NON DOMINANT	Rsa	Fracture lumbar vertebrae	Closed	Yes
25	KG	679147	59	f	housewife	1	226	Right	NON DOMINANT	Rsa	No	Closed	No
26	AKS	423083	37	m	dmc employee	0	193	Right	DOMINANT	Rsa	No	Closed	Yes
27	BS	705699	50	m	farmer	6	197	Right	NON DOMINANT	Rsa	Facial fractures	Open grade 2	Yes
28	LS	666902	40	m	dmc employee	1	635	Right	NON DOMINANT	Rsa	No	Closed	Yes
29	NK	7554	35	M	dmc employee	1	445	Right	NON DOMINANT	Rsa	No	Closed	No
30	PS	653079	41	F	TEACHER	2	291	Right	DOMINANT	Rsa	Fracture distal ulna left side	Closed	Yes
31	PKK	306088	77	F	housewife	2	299	Right	NON DOMINANT	Domestic fall	No	Closed	Yes
32	RS	716879	59	F	housewife	1	208	Right	NON DOMINANT	Domestic fall	No	Closed	Yes

S.NO	NAME	CR/MRD No	PRE OPERATIVE ASSESSMENT										OPERATIVE PROCEDURE		
			NATURE OF DISTAL RADIUS FRACTURE	DRUJ INSTABILITY STATUS	AXIAL INSTABILITY	ULNAR STYLOID FRACTURE TYPE	ULNAR BASE FRACTURE	PIANO KEY TEST	Ulnar Variance(mm)	ON X-ray Wrist PA view and lateral view			GA / REGIONAL ANAESTHESIA	TYPE OF PLATE USED	PLATE
										Radial Height	Widened DRUJ	Volar/Dorsal Tilt(IN DEGREES)			
1	AG	214881	2R3B1-1	NO	NO	NO	NO	Negative	-1	10mm	no	4 VENTRAL	Ra	Ldrs volar DER plate	SYNTHES
2	RS	427052	2R3C1-2	NO	NO	US BASE FRACTURE	YES	Negative	0	11mm	no	18 VENTRAL	Ra	VA Der plate	SYNTHES
3	HC	438969	2R3A2-1	NO	-	US FRACTURE OTHERS	NO	Negative	0	12mm	no	14 VENTRAL	Ga	Va DER plate	SYNTHES
4	BK	432163	2R3A2-2	AXIAL INSTABILITY	NEGATIVE AXIAL INSTABILITY	US FRACTURE OTHERS	NO	Negative	-3	5.5mm	no	12 VENTRAL	Ra	Va DER plate	SYNTHES
5	SG	445057	2R3C1-2	NO	NO	NO	NO	Negative	0	1.5MM	NO	8 VENTRAL	Ra	Va DER plate	SYNTHES
6	MP	389882	2R3A2-2	NO	NO	US FRACTURE OTHERS	NO	Negative	0	6MM	NO	30 DORSAL	Ra	Va DER plate	SYNTHES
7	SK	525616	2R3B1-1	NO	NO	US FRACTURE OTHERS	NO	Negative	-2	6MM	NO	7 VENTRAL	Ra	Va DER plate	SYNTHES
8	VK	511476	2R3C2-2	NO	NO	NO	NO	Negative	0	8mm	NO	8 VENTRAL	Ra	Va DER plate	SYNTHES
9	KR	529837	2R3C1-2	AXIAL INSTABILITY	NEGATIVE AXIAL INSTABILITY	US FRACTURE OTHERS	NO	Negative	-5	2MM	NO	20 VENTRAL	Ra	Va DER plate	SYNTHES
10	SK	559561	2R3B1-1	NO	NO	NO	NO	Negative	0	2.5	NO	24 VENTRAL	Ra	Va DER plate	SYNTHES
11	DS	578465	2R3A2-2	NO	NO	NO	NO	Negative	-1	5mm	no	23 DORSAL	Ga	Va DER plate	SYNTHES
12	GA	76264	2R3B3-1	AXIAL INSTABILITY	POSITIVE AXIAL INSTABILITY	US FRACTURE OTHERS	NO	Negative	4	3mm shortening	NO	20 VENTRAL	Ra	Ldrs DER plate	SYNTHES
13	GS	211599	2R3B1-1	AXIAL INSTABILITY	NEGATIVE AXIAL INSTABILITY	US FRACTURE OTHERS	NO	Negative	-4.5	3mm shortening	NO	16 VENTRAL	Ra	Va DER plate	SYNTHES
14	NJ	596934	2R3C3-1	NO	NO	US BASE FRACTURE	YES	Negative	1	4mm	NO	18 VENTRAL	Ra	Va DER plate	SYNTHES
15	SS	597774	2R3C1-2	BOTH	POSITIVE AXIAL INSTABILITY	US BASE FRACTURE	YES	Positive	4	1.5 MM shortening	YES	30 DORSAL	Ra	Va DER plate	SYNTHES
16	DS	613270	2R3A2-2	NO	NO	US FRACTURE OTHERS	NO	Negative	1	15mm	no	17 VENTRAL	Ra	ldrs der plate	KANGUI
17	TL	3881	2R3C1-2	AXIAL INSTABILITY	POSITIVE AXIAL INSTABILITY	US FRACTURE OTHERS	NO	Negative	4	1M	NO	18 VENTRAL	Ra	Va DER plate	SYNTHES
18	VK	633379	2R3C1-2	NO	NO	US FRACTURE OTHERS	NO	Negative	2	3.5	NO	5 DORSAL	Ra	Va DER plate	SYNTHES
19	KS	677289	2R3A2-3	BOTH	POSITIVE AXIAL INSTABILITY	US BASE FRACTURE	YES	Positive	3	2 mm shortening	yes	32 dorsal	Ga	Ldrs volar DER plate	SYNTHES
20	SJ	685926	2R3C1-2	AXIAL INSTABILITY	POSITIVE AXIAL INSTABILITY	US FRACTURE OTHERS	NO	Negative	4	8mm	no	27 DORSAL	Ga	Va DER plate	SYNTHES
21	RK	684389	2R3C1-2	NO	NO	NO	NO	Negative	0	3mm shortening	no	13 VENTRAL	Ga	Va DER plate	SYNTHES
22	CK	677267	2R3A2-2	NO	NO	NO	NO	Negative	0	4mm	no	13 VENTRAL	Ga	Va DER plate	SYNTHES
23	SA	733111	2R3C1-2	NO	NO	NO	NO	Negative	0	12mm	no	16 VENTRAL	Ra	Va DER plate	SYNTHES
24	AS	713837	2R3B1-1	NO	NO	US FRACTURE OTHERS	NO	Negative	0	7.8mm	no	17 VENTRAL	Ra	Ldrs DER plate	SYNTHES
25	KG	679147	2R3A2-2	NO	NO	NO	NO	Negative	2	11mm	no	30 DORSAL	Ra	Va DER plate	SYNTHES
26	AKS	423083	2R3C2-1	AXIAL INSTABILITY	NEGATIVE AXIAL INSTABILITY	NO	NO	Negative	-3	15mm	no	25 DORSAL	Ra	Ldrs DER plate	SORATH
27	BS	705699	2R3C1-2	anteroposterior INSTABILITY	NO	US BASE FRACTURE	YES	Positive	0	6mm	yes	8 VENTRAL	Ga	Va DER plate	SORATH
28	LS	666902	2R3C1-2	NO	NO	US FRACTURE OTHERS	NO	Negative	0	0	no	30 DORSAL	Ga	Ldrs DER plate	SYNTHES
29	NK	7554	2R3A2-1	NO	NO	US FRACTURE OTHERS	NO	Negative	0	6MM	NO	13 VENTRAL	Ra	Ldrs DER plate	SYNTHES
30	PS	653079	2R3C1-2	NO	NO	NO	NO	Negative	0	13	NO	17 VENTRAL	Ra	Va DER plate	SYNTHES
31	PKK	306088	2R3C1-2	NO	NO	US FRACTURE OTHERS	NO	Negative	0	8mm	NO	10 VENTRAL	Ra	Va DER plate	SYNTHES
32	RS	716879	2R3C1-2	NO	NO	US FRACTURE OTHERS	NO	Negative	0	4mm	NO	25 DORSAL	Ra	Va DER plate	SYNTHES

S.NO	NAME	CR/MRD No			POST OPERATIVE ASSESSMENT												
			NO OF HOLES	NO OF SCREWS	P/O ULNAR VARIANCE	P/O RADIAL HEIGHT	P/O WIDENED DRUJ	P/O VOLAR/ DORSAL TILT	RESULTS	FOLLOW UP: BASED ON GARTLAND AND WERLEY SCORE TOTAL SCORE AT LAST FOLLOW UP	INFECTION	DEFORMITY	ANGULATION	DISTAL ULNAR SIDED PAIN	DELAYED UNION/NON UNION	INADEQUATE REDUCTION	MEDIAN NERVE COMPRESSION
1	AG	214881	3	7	0	10	NO	8 DORSAL	Poor	14	No	No	No	No	No	No	No
2	RS	427052	3	8	-1	8	NO	6 DORSAL	Good	6	No	No	No	No	No	No	No
3	HC	438969	4	7	0	18	NO	14 DORSAL	Excellent	1	No	No	No	No	No	No	No
4	BK	432163	3	8	-1	11	NO	12 DORSAL	Excellent	2	No	No	No	No	No	No	No
5	SG	445057	2	5	0	12	NO	10 DORSAL	Excellent	2	No	No	No	No	No	No	No
6	MP	389882	4	7	0	14	NO	18 DORSAL	Fair	11	No	No	No	No	No	No	No
7	SK	525616	3	7	0	8	NO	20 DORSAL	Good	6	No	No	No	No	No	No	No
8	VK	511476	3	7	0	12	NO	16 DORSAL	Excellent	2	No	No	No	No	No	No	No
9	KR	529837	3	7	-1	10	NO	18 DORSAL	Fair	10	No	No	No	No	No	No	No
10	SK	559561	2	6	0	9	NO	4 VENTRAL	Good	7	No	No	No	No	No	No	No
11	DS	578465	3	9	0	8	NO	18 DORSAL	Excellent	1	No	No	No	No	No	No	No
12	GA	76264	3	3	0	10	NO	6 VENTRAL	Good	5	No	No	No	No	No	No	No
13	GS	211599	3	7	0	8	NO	10 DORSAL	Good	3	No	No	No	No	No	No	No
14	NJ	596934	4	8	-2	8	NO	8 DORSAL	Good	6	No	No	No	No	No	No	No
15	SS	597774	3	8	-1	7	YES	5 DORSAL	Fair	13	No	No	No	Yes	No	YES	No
16	DS	613270	3	5	-1	15	NO	8 DORSAL	Good	3	No	No	No	No	No	No	No
17	TL	3881	4	7	0	11	NO	3 DORSAL	Poor	22	No	No	No	Yes	No	No	No
18	VK	633379	3	6	0	8	No	10 DORSAL	Good	7	No	No	No	No	No	No	No
19	KS	677289	3	6	-1	6	No	12 DORSAL	Good	8	No	No	No	Yes	No	No	No
20	SJ	685926	2	8	-1	7	NO	12 DORSAL	Fair	10	No	No	No	Yes	No	No	No
21	RK	684389	3	7	0	6	YES	8 DORSAL	Good	5	No	No	No	No	No	YES	No
22	CK	677267	3	6	0	9	NO	7 DORSAL	Good	3	No	No	No	No	No	No	No
23	SA	733111	3	7	0	7	NO	9 DORSAL	Good	3	No	No	No	No	No	No	No
24	AS	713837	5	7	-2	7	NO	12 DORSAL	Good	5	No	No	No	No	No	No	No
25	KG	679147	3	8	0	15	NO	18 DORSAL	Good	3	No	No	No	No	No	No	No
26	AKS	423083	3	2	-2	7	NO	12 DORSAL	Good	3	No	No	No	No	No	No	No
27	BS	705699	3	6	-2	8	NO	8 DORSAL	Fair	14	No	No	No	No	No	No	Yes
28	LS	666902	3	5	0	7	NO	10 DORSAL	Excellent	2	No	No	No	No	No	No	No
29	NK	7554	3	7	0	12	NO	17 DORSAL	Excellent	1	No	No	No	No	No	No	No
30	PS	653079	3	6	-1	7	NO	9 DORSAL	Excellent	1	No	No	No	No	No	No	No
31	PKK	306088	3	8	-1	12	NO	16DORSAL	Fair	10	No	No	No	No	No	No	No
32	RS	716879	3	9	-1	7	NO	12 DORSAL	Excellent	1	No	No	No	No	No	No	No

S.NO	NAME	CR/MRD No	AGE (Year)	SEX	OCCUPATION	AVERAGE INTERVAL TO SURGERY	FOLLOW UP DURATION(DAYS	HAND DOMINANCE	INJURED HAND	MODE OF INJURY	OTHER ASSOCIATED FRACTURES	TYPE OF FRACTURE (CLOSED/OPEN GRADE I / II / III a / IIIb)	INTRA-ARTICULAR EXTENSION
33	SS	676628	18	M	STUDENT	18	196	Right	DOMINANT	Rsa	Bimalleolar fracture ankle	Closed	Yes
34	SS	733099	52	M	GOVT EMPLOYEE	0	201	Right	NON DOMINANT	Domestic fall	Fracture radial head right side	Closed	Yes
35	SS	704241	45	M	Business	2	229	Right	DOMINANT	Domestic fall	No	Closed	No
36	OK	202070	53	M	dmc employee	0	199	Right	NON DOMINANT	Domestic fall	No	Closed	Yes
37	RS	516233	43	M	Business	2	523	Right	NON DOMINANT	Rsa	No	Closed	Yes
38	LS	640380	37	M	Business	1	334	Left	NON DOMINANT	Rsa	Lisfranc injury left foot	Closed	Yes
39	SS	630327	53	M	DRIVER	4	357	Right	DOMINANT	Rsa	IPSILATERAL Fracture proximal humerus with brachial plexus injury, fracture distal ulna	Open grade 1	No
40	RA	606770	68	F	Business	1	398	Right	NON DOMINANT	Domestic fall	No	Closed	No
41	SK	425055	59	M	Business	0	209	Right	NON DOMINANT	Fall from height	Pelvic fracture	Closed	Yes
42	YK	737826	37	M	WORKER	0	191	Right	DOMINANT	Rsa	IPSILATERAL Fracture radial head and capitullum	Closed	Yes
43	PS	737854	70	M	Business	1	188	Right	NON DOMINANT	Rsa	Closed fracture proximal humerus right side	Closed	Yes
44	SS	493607	45	M	AGRICULTURE	1	306	Right	DOMINANT	Rsa	Bilateral DER fracture	Closed	Yes
45	SS	493607	45	M	AGRICULTURE	1	306	Right	NON DOMINANT	Rsa	Bilateral DER fracture	Closed	No

S.NO	NAME	CR/MRD No	PRE OPERATIVE ASSESSMENT										OPERATIVE PROCEDURE		
			NATURE OF DISTAL RADIUS FRACTURE	DRUJ INSTABILITY STATUS	AXIAL INSTABILITY	ULNAR STYLOID FRACTURE TYPE	ULNAR BASE FRACTURE	PIANO KEY TEST	Ulnar Variance(mm)	ON X-ray Wrist PA view and lateral view			GA / REGIONAL ANAESTHESIA	TYPE OF PLATE USED	PLATE
										Radial Height	Widened DRUJ	Volar/Dorsal Tilt(IN DEGREES)			
33	SS	676628	2R3C1-2	BOTH	NEGATIVE AXIAL INSTABILITY	NO	NO	Positive	-5	8mm	YES	30 DORSAL	Ra	Va DER plate	SYNTHES
34	SS	733099	2R3C1-2	NO	NO	US BASE FRACTURE	YES	Negative	0	8mm	NO	18 VENTRAL	Ga	Va DER plate	SYNTHES
35	SS	704241	2R3A2-3	NO	NO	NO	NO	Negative	0	5MM	NO	11 VENTRAL	Ra	Va DER plate	SORATH
36	OK	202070	2R3C1-2	AXIAL INSTABILITY	POSITIVE AXIAL INSTABILITY	US FRACTURE OTHERS	NO	Negative	5	2mm	NO	12 VENTRAL	Ga	Va DER plate	SORATH
37	RS	516233	2R3C1-2	NO	NO	US FRACTURE OTHERS	NO	Negative	2	3mm shortening	NO	8 VENRAL	Ra	Ldrs DER plate	SYNTHES
38	LS	640380	2R3C1-2	NO	NO	US FRACTURE OTHERS	NO	Negative	2	7MM	NO	11 VENTRAL	Ga	Va DER plate	SYNTHES
39	SS	630327	2R3A3-3	BOTH	POSITIVE AXIAL INSTABILITY	US FRACTURE OTHERS	NO	Positive	10	5MM	YES	10 VENTRAL	Ga	Ldrs DER plate	MIRACULUS
40	RA	606770	2R3A2-2	NO	NO	US FRACTURE OTHERS	NO	Negative	0	4MM	NO	15 VENTRAL	Ra	Va DER plate	SYNTHES
41	SK	425055	2R3C1-2	NO	NO	US FRACTURE OTHERS	NO	Negative	0	6MM	NO	18 VENTRAL	Ra	Ldrs DER plate	MIRACULUS
42	YK	737826	2R3C1-2	NO	NO	NO	NO	Negative	2	6MM	NO	DORSAL	Ra	Va DER plate	SYNTHES
43	PS	737854	2R3C1-2	NO	NO	NO	NO	Negative	2	6MM	NO	VENTRAL	Ra	Va DER plate	SYNTHES
44	SS	493607	2R3B1-1	NO	NO	NO	NO	Negative	0	8mm	NO	12 VENTRAL	Ga	Va DER plate	SYNTHES
45	SS	493607	2R3A1	NO	NO	US FRACTURE OTHERS	NO	Negative	-1	11mm	NO	8 VENTRAL	Ga	Va DER plate	SYNTHES

S.NO	NAME	CR/MRD No			POST OPERATIVE ASSESSMENT												
			NO OF HOLES	NO OF SCREWS	P/O ULNAR VARIANCE	P/O RADIAL HEIGHT	P/O WIDENED DRUJ	P/O VOLAR/ DORSAL TILT	RESULTS	FOLLOW UP: BASED ON GARTLAND AND WERLEY SCORE TOTAL SCORE AT LAST FOLLOW UP	INFECTION	DEFORMITY	ANGULATION	DISTAL ULNAR SIDED PAIN	DELAYED UNION/NON UNION	INADEQUATE REDUCTION	MEDIAN NERVE COMPRESSION
33	SS	676628	3	8	0	12	YES	15 DORSAL	Poor	24	No	No	No	Yes	No	YES	No
34	SS	733099	3	9	0	13	NO	6 DORSAL	Fair	10	No	No	No	No	No	No	No
35	SS	704241	3	5	0	12	NO	8 DORSAL	Good	3	No	No	No	No	No	No	No
36	OK	202070	3	8	0	7	NO	14 DORSAL	Good	4	No	No	No	Yes	No	No	No
37	RS	516233	5	8	0	8	NO	8 DORSAL	Good	4	No	No	No	No	No	No	No
38	LS	640380	3	6	0	14	NO	15 DORSAL	Excellent	1	No	No	No	No	No	No	No
39	SS	630327	10	9	0	12	YES	19 DORSAL	-	-	No	No	No	Yes	No	No	No
40	RA	606770	3	9	0	10	NO	12 DORSAL	Good	4	No	No	No	No	No	No	No
41	SK	425055	3	7	0	9	NO	16 DORSAL	Good	5	No	No	No	No	No	No	No
42	YK	737826	2	6	0	12	NO	10 DORSAL	Fair	14	No	No	No	No	No	No	No
43	PS	737854	3	8	0	8	NO	12 DORSAL	Good	3	No	No	No	No	No	No	No
44	SS	493607	3	7	0	6	NO	11 DORSAL	Good	3	No	No	No	No	No	No	No
45	SS	493607	2	6	0	7	NO	8 DORSAL	Good	3	No	No	No	No	No	No	No

Baba Farid University
of Health Sciences
Sadiq Road
Faridkot-151 203 (Pb). INDIA.
Phone : 01639-256232,256236
Tele/Fax : 01639-256235
Email – Examination@bfuhs.ac.in

No. BFUHS/2K18p-TH/ 14457 Date 4/10/18

The Principal,
DMC, Ludhiana.

Subject: Approval of Plan of Thesis.

This is to inform you that the Faculty of Medical Sciences in its meeting held on 31.08.2018 has approved the plan of thesis of Dr. Sanjay Jain, a student of your college for MS Orthopaedics along with the names of Supervisor/Co-Supervisor as under:-

Topic Plan of Thesis
Effect of distal radio ulnar joint (druj) involvement on outcome of distal radius fractures

Supervisor
Dr. Deepak Jain
Assoc. Prof.,
Dept. of Orthopaedics,
DMCH, Ludhiana.

Co-Supervisor
Dr. M. Yamin
Prof.,
Dept. of Orthopaedics,
DMCH, Ludhiana.

Dr. Harpal Singh Selhi
Prof.,
Dept. of Orthopaedics,
DMCH. Ludhiana..

The student may submit the four copies of thesis, to the Controller of Examinations, BFUHS, Faridkot, at least six months before the commencement of theory examination, if he/she is otherwise eligible to take the examination. He /She may be directed to attach a photocopy of this letter with the forwarding letter while submitting thesis in the University along with the letter of approval of University for change of supervisor/Co-Supervisor, change of topic, if any.

S P Singh

Dr. S P Singh MS(Oph)
Controller of Examinations

Note :

1. *If any discrepancy found regarding topic of thesis or Supervisor/Co-Supervisor, inform undersigned within one month after issue of this letter.*
2. *The student may submit the thesis as per the schedule already conveyed i.e for May/June examination 30th Nov of the preceding the year of examination and for Nov/Dec examinations 31st May of the year of examination.*

EFFECT OF DISTAL RADIO ULNAR JOINT (DRUJ) INVOLVEMENT ON OUTCOME OF DISTAL RADIUS FRACTURES

THESIS PROPOSAL

FOR APPROVAL OF SUBJECT OF THESIS TO BE SUBMITTED

IN PARTIAL FULFILMENT OF THE REQUIREMENTS

FOR THE DEGREE OF

MASTER OF SURGERY

IN

ORTHOPAEDICS

OF THE

BABA FARID UNIVERSITY OF HEALTH SCIENCES

FARIDKOT

JANUARY, 2018

DR. SANJAY JAIN

DEPARTMENT OF ORTHOPAEDICS

DAYANAND MEDICAL COLLEGE & HOSPITAL, LUDHIANA

ABSTRACT OF PLAN OF THESIS

Title	EFFECT OF DISTAL RADIO ULNAR JOINT (DRUJ) INVOLVEMENT ON OUTCOME OF DISTAL RADIUS FRACTURES
For the degree of	MS Orthopaedics
Name of the candidate	Dr. Sanjay Jain
Supervisor	Dr. Deepak Jain, Associate Professor, Department of Orthopaedics, DMCH, Ludhiana.
Co-supervisors	Dr. M Yamin, Professor, Department of Orthopaedics, DMCH, Ludhiana. Dr. Harpal Singh Selhi, Professor, Department of Orthopaedics, DMCH, Ludhiana.
Institution	Dayanand Medical College & Hospital, Ludhiana
University	Baba Farid University of Health Sciences, Faridkot

Introduction: Fracture distal radius is an injury seen with high frequency, representing approximately one sixth of all fractures seen in emergency departments.Distal radio ulnar joint injuries associated with distal radius fractures remain an injury that fosters considerable interest and debate.

Aim: To study the effect of distal radio ulnar joint (DRUJ) involvement on outcome of distal radius fractures.

Material & Methods: It is a prospective study of patients with distal radius fractures managed with volar plating at Dayanand medical college Ludhiana between January 2018 to May 2019 who will be followed up till minimum of six months.

Clinical Significance: The study will show the need for anatomic restoration of distal radio ulnar joint in patient with distal radius fractures managed with volar plating and its effect on decreasing residual deformity in post-operative patients.The study will act as a benchmark to set up guidelines for management of distal radius fractures with distal radio ulnar injuries.

Keywords: Distal radio ulnar joint, distal radio fracture, volar plating

(Signature)	(Signature)	(Signature)	(Signature)	(Signature)
Candidate	Co-supervisor	Co-supervisor	Supervisor	Principal

CERTIFICATE OF FACILITIES AVAILABLE

This is to certify that the facilities for work on the subject of thesis titled **"EFFECT OF DISTAL RADIO ULNAR JOINT (DRUJ) INVOLVEMENT ON OUTCOME OF DISTAL RADIUS FRACTURES"** exist in the Department of Orthopaedics, DMC&H, Ludhiana, and will be provided to the candidate. We will see that the data being included in the thesis are genuine and is collected by the candidate himself under our supervision and guidance.

Supervisor:

Dr. Deepak Jain
Associate Professor
Department of Orthopaedics
DMC&H, Ludhiana

Co-Supervisor(s):

Dr. M Yamin
Professor
Department of Orthopaedics
DMC&H, Ludhiana

Dr. Harpal Singh Selhi
Professor
Department of Orthopaedics
DMC&H, Ludhiana

Dr. Rajnish Garg
Professor & Head
Department of Orthopaedics
DMCH, Ludhiana

Place: Ludhiana

Date: 18/1/18

APPROVAL PROFORMA
BY RESEARCH & ETHICAL COMMITTEE
DAYANAND MEDICAL COLLEGE & HOSPITAL, LUDHIANA

Name of candidate	Dr. Sanjay Jain
Department	Orthopaedics
Topic of Thesis	EFFECT OF DISTAL RADIO ULNAR JOINT (DRUJ) INVOLVEMENT ON OUTCOME OF DISTAL RADIUS FRACTURES
Likely date of appearing in PG examination	JUNE 2020
Date of enrollment	31.05.2017
Name of Head of Department	Dr. RAJNISH GARG
1. **Supervisor** 2. **Co-Supervisor**	Dr. Deepak Jain Dr. M Yamin Dr. Harpal Singh Selhi
Signature of Members of Research Committee with Stamp	**Signature of Members of Ethics Committee with Stamp**
1. HOD Pharmacology	1. HOD Physiology
2. HOD Surgery	2. HOD Pathology
3. HOD Pathology	3. HOD Pharmacology
4. HOD Medicine	4. HOD SPM
5. Dean Academics	5. HOD Medicine
6. Vice Principal	7. HOD Surgery
	7. HOD Obst. & Gynae.
	8. Legal Expert
	9. secretary, IEC
	10. Dean Academics
	11. Vice Principal
	12. Principal

Approved: Yes / No

Chairperson
Research Committee

Chairperson
Research Committee

Approved: Yes / No

Chairperson
Ethics Committee

Chairperson
Ethics Committee

BABA FARID UNIVERSITY OF HEALTH SCIENCES FARIDKOT

PROFORMA FOR REGISTRATION OF SUBJECT FOR DISSERTATION

1	NAME OF THE CANDIDATE AND ADDRESS	DR. SANJAY JAIN HOUSE NO 3647, JANDIALA GURU DISTRICT AMRITSAR.
2	NAME OF THE INSTITUTE	DAYANAND MEDICAL COLLEGE AND HOSPITAL, LUDHIANA
3	COURSE OF STUDY AND SUBJECT	MASTER OF SURGERY, ORTHOPAEDICS
4	DATE OF ADMISSION OF COURSE	31.05.2017
5	TITLE OF THE TOPIC	EFFECT OF DISTAL RADIO ULNAR JOINT(DRUJ) INVOLVEMENT ON OUTCOME OF DISTAL RADIUS FRACTURES

6. BRIEF RESUME OF INTENDED WORK:

6.1 NEED FOR STUDY

Distal radioulnar joint is a trochoid joint relatively new in evolution. Along with proximal radioulnar joint, forearm bones and interosseous membrane, it allows pronosupination and load transmission across the wrist. Injuries around distal radioulnar joint are not uncommon, and are usually associated with distal radius fractures, fractures of the ulnar styloid and with the eponymous Galeazzi or Essex Lopresti fractures.

Distal radio ulnar joint injuries associated with distal radius fractures remain an injury that fosters considerable interest and debate. Fracture distal radius is an injury seen with high frequency, representing approximately one sixth of all fractures seen in emergency departments.

Distal radioulnar joint injuries are the most common cause of residual wrist disability after fractures of the distal radius.The conditions that produce radioulnar pain and limitation of forearm rotation include instability, joint incongruency, and ulnocarpal abutment. These can cause irreversible cartilage damage that eventually leads to degenerative joint disease.

There is also high incidence of Malunion even after the fracture is healed. Malunion of the distal radius has been associated with pain, stiffness, weak grip strength and carpal instability in a significant percentage of patients. Early recognition and management at the acute stage aims at the anatomic reconstruction of the distal radioulnar joint.

Long term consequences include degenerative arthritis in up to 50% of patients with even minimal displacement in the young adult population. .

Treatment of distal radio ulnar joint injuries associated with fracture distal

radius is controversial: there is no single definitive treatment method that is considered the standard of care.

There are numerous treatment modalities available to orthopaedic surgeons in the treatment of these injuries; these include closed reduction and casting, closed reduction and percutaneous pinning by different methods such as Kapandiji intrafocal pinning, transradial styloid pinning, pinning via the Listers tubercle or transulnar pinning. Other modalities of treatment include closed reduction and external fixation by means of ligamentotaxis to realign fracture displacement, open reduction by volar or dorsal approach and internal fixation by different implants such as screws, plates, or screws with locking plate.

While deciding the treatment modality there are numerous factors to consider before finalizing the most appropriate one for each patient, these include the patient's age, lifestyle, associated injuries, co-morbidities, functional demands, dominance of hand, type of fracture, alignment of fracture, condition of soft tissues, whether the fracture is open or closed and economic constraints of the patient. All these factors play a paramount role in the final decision in the treatment of the distal radio ulnar injuries associated with fracture distal radius. limited literature is available for the incidence, management and outcomes of these injuries.

6.2 REVIEW OF LITERATURE

Distal radius fractures are one of the most common injuries encountered in orthopedic practice. They make up 8%–15% of all bony injuries in adults. Abraham Colles is credited with description of the most common fracture pattern affecting distal end radius in 1814, and is classically named after him.

Ki-Bum Choi et al in 2012 conducted a study on Treatment of Distal Radioulnar Joint Injuries Associated with a Distal Radius Fracture. They observed that distal radius fractures involving distal radioulnar joint (DRUJ) are common. After the fracture treatment, pain on the ulnar side of wrist, limitation of forearm rotation and instabilities can be remained. The purpose of their study was to address the importance of anatomical reduction for DRUJ injuries. This study concluded that in Distal radius fractures involving DRUJ immediate anatomical reduction is needed by operative treatment to avoid painful forearm rotation.[1]

Ishikawa j et al in 2005 conducted a study on Influence of distal radioulnar joint subluxation on restricted forearm rotation after distal radius fracture and concluded that the subluxation of the DRUJ was related to restricted forearm rotation. The radiographic parameters of palmar tilt and ulnar variance showed an adverse influence on the position of the ulnar head at the DRUJ, which might lead to restricted forearm rotation after distal radial fracture.[2]

Bong Cheol Kwon et al in 2012 conducted study of Clinical and Radiographic Factors Associated with Distal Radioulnar Joint Instability in Distal Radius Fractures. They observed that Distal radioulnar joint (DRUJ) instability is an important cause of ulnar-sided wrist pain in distal radius fractures. Widening of the DRUJ gap was identified as an independent risk factor for DRUJ

instability in distal radius fractures. In their study, they tried to identify clinical and radiographic factors associated with DRUJ instability in distal radius fractures.[3]

Fujitani R et al in 2014 conducted a study on Radiographic Predictors of DRUJ Instability with Distal Radius Fractures. They analysed that, a radiographic finding of widening of DRUJ gap distance on a posteroanterior view was the most important predictor to identify DRUJ instability accompanying an unstable distal radius fracture. They concluded that radioulnar dissociation likely occurs when there is DRUJ instability following fracture displacement and a complete deep radioulnar ligament tear.[4]

Omori et al in 2012 investigated three-dimensional changes in the length of the radioulnar ligament in patients with malunited distal radius fractures using computed tomography (CT). They found that, in a malunited radius, the superficial and deep dorsal limbs of the radioulnar ligament were significantly elongated compared with the contralateral side. This length change correlated with radiographic radial shortening and subluxation of the DRUJ. They suggested that overstretching and disruption of the dorsal radioulnar ligament in malunited distal radius fractures with severely increased radial shortening produces laxity in the DRUJ.[5]

Saito et al in 2013conducted a biomechanical study examining the effects of dorsal angulation deformity and radioulnar ligament tears on DRUJ stability. The DRUJ stiffness in dorsal translation decreased significantly with dorsal tilts of 10° and 20° in pronation. Subsequent transection of the superficial and deep radioulnar ligaments resulted in a significant decrease of the DRUJ stiffness in in all forearm positions. The authors concluded that the dorsal

angulation of the radius should be corrected to less than 10° of dorsal tilt to avoid DRUJ instability.[6]

Nakanishi et al in 2013 studied DRUJ widening in radioulnar ligament tears: They analyzed fracture patterns and displacement in the DRUJ using three-dimensional CT scans of intra-articular distal radius fractures. Of the 72 fractures analyzed, 8% had dorsal comminution and displacement of the DRUJ, which may increase the risk for DRUJ instability.[7]

May et al in 2002 reported that an associated ulnar styloid fracture occurred in 143 of 166 patients (86%) with distal radius fractures. Fractures at the base of the ulnar styloid and major displacement of an ulnar styloid fracture were both found to increase the risk of DRUJ instability.[8]

Bombaci et al in 2006 conducted a prospective study of postreduction magnetic resonance imaging (MRI) data for 60 consecutive patients with distal radius fractures to determine the radiographic predictors of a TFCC injury. They concluded that although there is no robust evidence on whether associated soft tissue injury affects clinical outcomes for treating wrist fractures, knowledge of the predictors of DRUJ instability is important.[9]

William B. Geissler et al in 1996 conducted a study of distal radioulnar joint injuries associated with fractures of the distal radius. They concluded that there is a wide variety of injuries to the distal radioulnar joint occurring in combination with distal radius fractures. Clinical, radiographicand arthroscopic assessment should be routinely employed to identify the degree and extent of the lesion. A successful result is usually dependent on restoration of the joint anatomy. This can be accomplished depending on the lesion with conservative or operative measures. Equally important for the final outcome is

early recognition of the injury, assessment of residual instability, awareness of probable progressive dorsal subluxation if cast free after treatment is used, and early treatment of the condition before scarring occurs.[10]

Stoffelen D et al in 1998 studied the importance of the distal radioulnar joint in distal radial fractures and observed that distal radioulnar joint plays an important role in the outcome of distal radial fractures. An ulnar styloid fracture has a negative effect on outcome and so does involvement of the distal radioulnar joint, as tested with instability tests and forearm rotation strength.[11]

Liu J et al in 2014 conducted a study titled Should distal radioulnar joint be fixed following volar plate fixation of distal radius fracture with unstable distal radioulnar joint? In their study, they found that in patients with distal radius fractures, fixation of unstable DRUJs in neutral for 6 weeks does not have an advantage over non-fixation .they questioned whether distal radioulnar joint should be fixed following volar plate fixation of distal radius fracture with unstable distal radioulnar joint. In their study, their study demonstrated that following open reduction and internal fixation of distal radius with volar plates in patients with distal radius fractures, fixation of unstable DRUJs in neutral for six weeks does not have an advantage over non-fixation for a short period.[12]

Jae Kwang Kim et al in 2011 conducted a study on Comparison of united and non united fractures of the ulnar styloid following volar-plate fixation of distal radius fractures. In their study, they recruited a relatively well-controlled study population of patients with an unstable DRF (treated by open reduction and volar plating) and an accompanying ulnar styloid fracture to determine whether associated nonunion of ulnar styloid fracture has any effect on wrist

function, ulnar sided wrist pain or DRUJ instability. They concluded that ulnar-sided wrist pain is probably related to an initial high-energy injury rather than ulnar styloid nonunion. They concluded that Ulnar styloid nonunion does not appear to affect wrist functional outcomes, ulnar-sided wrist pain or DRUJ stability, at least when a DRF is treated by open reduction and volar plate fixation.[13]

Jong Pil Kim et al in 2008 studied Assessment of Distal Radioulnar Joint Instability After Distal Radius Fracture: Comparison of Computed Tomography and Clinical Examination Results purpose of their study was to compare computed tomography (CT) and clinical stress test findings in terms of the assessment of distal radioulnar joint (DRUJ) instability after distal radius fracture. They found that DRUJ instability diagnosed by the stress test and by CT showed no statistical correlation with radiographic parameters, but instability determined by CT appeared to be related to dorsal tilt deformity. They concluded that after distal radius fracture, CT assessments of DRUJ instability were found to be influenced by residual deformities, such as dorsal tilt, but not well correlated with stress test findings.[14]

Perugia Dario et al in 2014 conducted a study titled Is it really necessary to restore radial anatomic parameters after distal radius fractures? They observed that small variations within normal range of radiographic parameters, except ulnar variance and volar tilt, do not influence the final functional outcome in distal radius fractures. Their aim was to verify if it is really necessary to restore anatomic radiographic parameters to obtain satisfactory functional outcome in distal radius fractures treated with volar plate..they concluded that ulnar variance and volar tilt are the most important

radiographic parameters to be restored to obtain good functional outcome in distal radius fracture.[15]

Gholam Hossein Kazemian et al in 2011 studied about DRUJ instability after distal radius fracture: A comparison between cases with and without ulnar styloid fracture Their study was designed to assess the relationship between ulnar styloid fracture and the incidence of DRUJ instability after treatment of distal radius fractures treated with volar plating. Their study demonstrated that untreated stable or minimally displaced ulnar styloid fracture accompanied by distal radius fracture, has no adverse effect on DRUJ stability following volar plating of the radius.[16]

6.3 AIMS AND OBJECTIVES OF THE STUDY

To study the effect of distal radio ulnar joint (DRUJ) involvement on outcome of distal radius fractures.

7.0 MATERIALS AND METHODS

7.1 SOURCE OF DATA

It is a prospective study of patients with distal radius fractures managed with volar plating at Dayanand medical college Ludhiana between January 2018 to May 2019 who will be followed up till minimum of six months. Pre operative assessment will include assessment of type of fracture, clinical and radiological assessment of distal radio-ulnar joint instability. Intraoperative assessment will be done clinically (piano key test/Ballotment test after distal radius fracture fixation). Post operative assessment will be done on basis of radiological (ulnar variance and dorsal/volar tilt) and Modified Gartland and Werley score.

7.2 METHOD OF COLLECTION OF DATA

Inclusion Criteria:

1. Patient age more than 18 years(skeletally mature patient)
2. Distal end radius fracture managed with volar plating

C. Exclusion Criteria:

1. Skeletally immature patient
2. Distal radius fracture managed conservatively by slab/cast/closed reduction and internal fixation with k-wires/ external fixator

Following admission, complete history and pre operative work up will be noted regarding the mode of injury, severity of trauma, type of fracture, distal radio-ulnar joint involvement. All patients will be examined for deformity, swelling, tenderness, bony irregularities of distal radius and relative position of radial and ulnar styloid process will be noted. AO/OTA classification will be used for

classification of distal radius fractures. Movements of the wrist and hand will be evaluated. Open reduction and internal fixation (volar plating) will be done under image intensifier guidance. DRUJ injury will be assessed and managed accordingly. Splintage will be given if required by the fixation construct. Immediate Postoperative check x-rays will be taken in both PA and Lateral views.

Patients will be discharged with routine aseptic dressing instructions with active finger, elbow and shoulder exercises. All cases will be followed up after two weeks, six weeks and at monthly interval till radiological union and functional recovery or six months whichever is later. Patients will be assessed clinically for fracture union, range of movements and radiological parameters. Any complication/Residual deformity/ secondary procedures will be recorded. Modified Gartland and Werley score will be calculated at 12 weeks and final followup

AO CLASSIFICATION OF DISTAL RADIUS FRACTURE:

A. EXTRAARTICULAR METAPHYSEAL FRACTURE

A1: ISOLATED FRACTURE OF DISTAL ULNA

A2: SIMPLE RADIAL FRACTURES

A3: RADIAL FRACTURE WITH METAPHYSEAL IMPACTION

B. INTRA-ARTICULAR RIM FRACTURE

B1: FRACTURE OF RADIAL STYLOID

B2: DORSAL RIM FRACTURES

B3: VOLAR RIM FRACTURE

C. COMPLEX INTRA-ARTICULAR FRACTURE

C1: RADIO CARPAL JOINT CONGRUITY PRESERVED, METAPHYSIS FRACTURE

C2: ARTICULAR DISPLACEMENT

C3: DISPHYSEAL METAPHYSEAL INVOLVEMENT

Functional scoring system according to **Modified Gartland and Werley**

Score:

I Residual Deformity

1. Prominent Ulnar Styloid	1
2. Residual dorsal tilt	2
3. Radial deviation of hand	2-3
Point range	0-3

II Subjective Evaluation

1. EXCELLENT No pain, disability or limitation of motion	0
2. GOOD-occasional pain, slight limitation of motion	2
3. FAIR:Occasional pain, some limitation of motion; feeling of weakness in wrist, no particular disability if careful, activities slightly restricted	4
4. POOR: Pain, limitation of motion; disability, activities restricted	6
Point range	0-6

III Objective evaluation:

1. Loss of dorsiflexion	5
2. Loss of ulnar deviation	3
3. Loss of supination	2
4. Loss of palmar flexion	1
5. Loss of radial deviation	1

6. Loss of circumduction	1
7. Loss of pronation	2
8. Pain in distal radioulnar joint	1
9. Grip strength-60% or less of opposite side	1
Point range	0-5

IV Complications

Arthritic change

1. Minimum	1
2. Minimum with pain	3
3. Moderate	2
4. Moderate with pain	4
5. Severe	3
6. Severe with pain	5
Nerve complication (median)	1-3
Point range	0-5

VI. Total score

Excellent	0-2
Good	3-8
Fair	9-20

Poor 21 and above

OUTCOME

The final functional outcome will be graded as Excellent (Score 0 to 2). Good (Score 3 To 8). Fair (Score 9 to 20) and poor (Score 21 and above) and documented in the rating sheet as per the Modified Gartland and Werley scoring system.

STATISTICAL ANALYSIS

The data collected will be recorded in a proforma and will be analyzed using appropriate observational statistical methods.

7.3 DOES THE STUDY REQUIRE ANY INVESTIGATIONS OR INTERVENTIONS TO BE CONDUCTED ON PATIENTS OR OTHER HUMANS OR ANIMALS? IF SO, PLEASE DESCRIBE BRIEFLY.

Yes, the study will require following investigation

1. xray wrist pa/lateral

7.4 HAS THE ETHICAL CLEARANCE BEEN OBTAINED FROM ETHICAL COMMITTEE OF YOUR INSTITUTION IN CASE OF 7.3?

Yes, attached here with.

8. LIST OF REFERENCES

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12. Liu J, Wu Z, Li S, Li Z, Wang J, Yang C, et al. Should distal radioulnar joint be fixed following volar plate fixation of distal radius fracture with unstable distal radioulnar joint? Orthop Traumatol Surg Res. 2014;100(6):599-603.
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15. Dario P, Matteo G, Carolina C, Marco G, Cristina D, Daniele F, et al. Is it really necessary to restore radial anatomic parameters after distal radius fractures? Injury. 2014;45:S21-6.
16. Kazemian GH, Bakhshi H, Lilley M, Omidian MM, Safdari F, Mohammadpour I, et al. DRUJ instability after distal radius fracture: A comparison between cases with and without ulnar styloid fracture. Int J Surg. 2011;9(8):648-51.

PROFORMA

NAME: AGE: SEX:

ADM No: CR/MRD No:

ADDRESS: DATE OF ADMISSION:

OCCUPATION: DATE OF DISCHARGE:

DATE OF INJURY: DATE OF OPERATION:

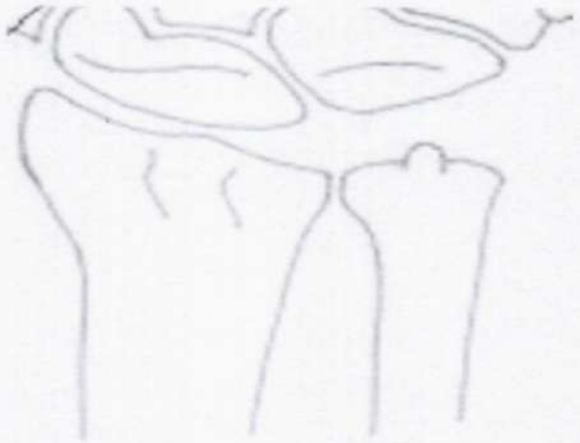
HAND DOMINANCE:

MODE OF INJURY: ROAD SIDE ACCIDENT / FALL / ASSAULT / OTHERS

OTHER ASSOCIATED FRACTURES:

PRE OPERATIVE ASSESSMENT:

TYPE OF FRACTURE: CLOSED/OPEN GRADE I / II / III a / IIIb



INTRA-ARTICULAR EXTENSION: YES/NO

NATURE OF DISTAL RADIUS FRACTURE: BASED ON AO CLASSIFICATION

Signature of Candidate Signature of Supervisor

DISTAL RADIO ULNAR JOINT INSTABILITY:

CLINICAL: PIANO KEY TEST

DISPLACEMENT

TENDERNESS AT ULNAR STYLOID

RADIOLOGICAL: ON X-ray Wrist PA view:

Ulnar Variance Radial Height Widened DRUJ

On X-ray Wrist Lateral View: Volar/Dorsal Tilt

Distal Ulna Fracture: Yes/No

Associated Injuries:

INTRA-OPERATIVE EXAMINATION:

OPERATION/PROCEDURE:

ANAESTHESIA USED: GA / REGIONAL ANAESTHESIA

TYPE OF PLATE USED:

NO OF HOLES:

NO OF SCREWS

Signature of Candidate **Signature of Supervisor**

POST OPERATIVE ASSESSMENT:

FOLLOW UP: BASED ON MODIFIED GARTLAND AND WERLEY SCORE

	12 weeks	Last follow up
RESIDUAL DEFORMITY 1.PROMINANT ULNAR STYLOID 2. RESIDUAL DORSAL TILT 3. RESIDUAL DEVIATION OF HAND **SUBJECTIVE EVALUATION** 1.EXCELLENT No pain, disability or limitation of motion 2.GOOD-occasionalpain, slight limitation of motion, no disability 3.FAIR:-Occasional pain, some limitation of motion; feeling of weakness in wrist, no particular disability if careful, activities slightly restricted 4. POOR: Pain, limitation of motion; disability, activities restricted **III Objective evaluation:** 1. Loss of dorsiflexion 2. Loss of ulnar deviation 3. Loss of supination 4. Loss of palmar flexion 5. Loss of radial deviation 6. Loss of circumduction 7. Loss of pronation 8. Pain in distal radioulnar joint 9. Grip strength-60% or less of opposite side **IV Complications** **Arthritic change** 1. Minimum 2. Minimum with pain 3. Moderate 4. Moderate with pain 5. Severe 6. Severe with pain Nerve complication (median) **VI. Total score** **RADIOLOGICAL UNION**		

Signature of Candidate **Signature of Supervisor**

COMPLICATIONS:

INFECTION:

DEFORMITY:

ANGULATION:

DISTAL ULNAR SIDED PAIN:

DELAYED UNION/NON UNION:

INADEQUATE REDUCTION:

MEDIAN NERVE COMPRESSION:

Signature of Candidate **Signature of Supervisor**

INFORMED PATIENT CONSENT

Date: _____

I.....D/o, W/o, S/o.....

am willing to participate in the study **"EFFECT OF DISTAL RADIO ULNAR JOINT (DRUJ) INVOLVEMENT ON OUTCOME OF DISTAL RADIUS FRACTURES"** The procedure with its complications has been explained to me in local vernacular language. I have fully understood that no special tests and extra expenditure in any form, merely for the purpose of thesis is being carried out. I am free to opt out the study any time without assigning any reason.

.....
Signature of the Witness

Name:

.....
Signature of the patient

Signature of Candidate

Signature of Supervisor

मरीज अनुमति फार्म

तिथि _____

मैं _____ पत्नी/पुत्र/पुत्री _____

निवासी _____

इस शोधकार्य **"EFFECT OF DISTAL RADIO ULNAR JOINT (DRUJ) INVOLVEMENT ON OUTCOME OF DISTAL RADIUS FRACTURES"** में भाग लेने के लिए सहमत हूँ। मैं इस शोधकार्य में भाग लेने के लिए अपनी स्वेच्छा से तैयार हूँ। मैं पुष्टि करता/करती हूँ की यह स्वीकृति देने के लिए मुझे कोई आर्थिक प्रलोभन नहीं दिया गया और न ही दबाव डाला गया है। मुझे इस शोधकार्य का उद्देश्य स्पष्ट कर दिया गया है और मुझे यह विश्वास है की यह विज्ञान और मानवता के लाभ के लिए है। मुझे इस शोधकार्य में होने वाले जोखिम के बारे में समझा दिया गया है और मेरी समझ में यह जोखिम बहुत मामुली है।

मैं इस शोधकार्य में भाग लेने के सम्बन्ध में किसी भी समय अपनी अस्वीकृति व्यक्त कर सकता/सकती हूँ और मेरे अस्वीकृति व्यक्त करने का मेरे इलाज पर कोई प्रभाव नहीं पड़ेगा।

_____ _____

गवाह के हस्ताक्षर रोगी के हस्ताक्षर/अंगूठे का निशान

नाम: नाम:

_____

अन्वेषक के हस्ताक्षर

_____

विद्यार्थी के हस्ताक्षर

ਮਰੀਜ਼ ਰਜ਼ਾਮੰਦੀ ਫਾਰਮ

ਮਿਤੀ_____

ਮੈ_____ਪਤਨੀ/ਪੁੱਤਰ/ਪੁੱਤਰੀ_____

ਵਾਸੀ _____

"EFFECT OF DISTAL RADIO ULNAR JOINT (DRUJ) INVOLVEMENT ON OUTCOME OF DISTAL RADIUS FRACTURES" ਤੇ ਚਲ ਰਹੀ ਖੋਜ ਵਿਚ ਹਿੱਸਾ ਲੈਣ ਲਈ ਰਜ਼ਾਮੰਦ ਹਾਂ। ਇਸ ਖੋਜ ਕੰਮ ਵਿਚ ਹਿੱਸਾ ਲੈਣ ਲਈ ਮੈ ਆਪਣੀ ਮਰਜ਼ੀ ਨਾਲ ਤਿਆਰ ਹਾਂ। ਮੈ ਇਹ ਦਸਣਾ ਚਾਹੁੰਦਾ ਹਾਂ/ ਚਾਹੁੰਦੀ ਹਾਂ ਕੇ ਇਹ ਰਜ਼ਾਮੰਦੀ ਦੇਣ ਵਾਸਤੇ ਮੈਨੂ ਕਿਸੇ ਵੀ ਤਰਾਂ ਦਾ ਲੋਭ-ਲਾਲਚ ਨਹੀ ਦਿੱਤਾ ਗਿਆ ਅਤੇ ਨਾ ਹੀ ਕੋਈ ਦਬਾ ਪਾਇਆ ਗਿਆ ਹੈ। ਮੈਨੂ ਇਸ ਖੋਜ ਦਾ ਮਨੋਰਥ ਸਮਝਾ ਦਿੱਤਾ ਗਿਆ ਹੈ ਅਤੇ ਮੈਨੂ ਇਹ ਭਰੋਸਾ ਦਵਾਇਆ ਗਿਆ ਹੈ ਕੇ ਇਹ ਖੋਜ ਵਿਗਿਆਨ ਅਤੇ ਮਾਨਵਤਾ ਦੀ ਭਲਾਈ ਲਈ ਹੈ। ਮੈਨੂ ਇਸ ਖੋਜ ਵਿਚ ਹੋਣ ਵਾਲੇ ਖਤਰੇ ਬਾਰੇ ਸਮਝਾ ਦਿੱਤਾ ਗਿਆ ਹੈ ਅਤੇ ਮੈਨੂ ਇਹ ਯਕੀਨ ਹੈ ਕੇ ਇਹ ਖਤਰਾ ਬਹੁਤ ਮਾਮੂਲੀ ਹੈ। ਮੈਨੂ ਇਸ ਖੋਜ ਕੰਮ ਵਿਚ ਹਿੱਸਾ ਲੈਣ ਦਾ ਢੰਗ – ਤਰੀਕਾ ਸਮਝਾ ਦਿੱਤਾ ਗਿਆ ਹੈ।

ਮੈ ਇਸ ਖੋਜ ਕੰਮ ਵਿਚ ਹਿੱਸਾ ਲੈਣ ਬਾਰੇ ਆਪਣੀ ਰਜ਼ਾਮੰਦੀ ਕਿਸੇ ਵੀ ਸਮੇ ਵਾਪਸ ਲੈ ਸਕਦਾ ਹਾਂ/ ਸਕਦੀ ਹਾਂ ਅਤੇ ਮੇਰੀ ਰਜ਼ਾਮੰਦੀ ਵਾਪਸ ਲੈਣ ਦਾ ਮੇਰੇ ਇਲਾਜ ਤੇ ਕੋਈ ਅਸਰ ਨਹੀ ਹੋਵੇਗਾ।

_____ _____

ਗਵਾਹ ਦੇ ਹਸਤਾਖਰ ਮਰੀਜ਼ ਦੇ ਹਸਤਾਖਰ

ਮਿਤੀ_____ ਮਿਤੀ_____

ਪਤਾ _____ ਪਤਾ _____

_____

ਨਿਰੀਖਕ ਦੇ ਹਸਤਾਖਰ

_____

ਸਿਖਿਆਰਥੀ ਦੇ ਹਸਤਾਖਰ